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EXPERIMENTAL AND NUMERICAL ANALYSIS OF A CROSSFLOW FAN

by

Wee Teck Cheng

December 2003

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13. ABSTRACT (maximum 200 words)

An auto vehicle that can take off and land vertically is envisioned to solve current and future problems of road congestion by utilizing the enormous air space above us. Crossflow Fan has been looked into in the past to serve this purpose but not sufficient to justify its capability to provide enough vertical thrust with limited power and space. Hence more in depth study is required to further improve the thrust efficiency and thrust to power ratio to a point where this thrust producing method is viable.

A 12-inch diameter, 1.5-inch span, 30-blade Crossflow fan test apparatus was constructed and tested using an existing Turbine Test Rig as a power source. Instrumentation was installed and a data acquisition program was developed to measure the performance of the Cross Flow Fan. Performance measurement was taken over a speed range of 1,000 to 6,000 RPM.

An experiment was conducted with the Cross Flow Fan to determine among other things the stalling characteristics of the compressor. Performance and flow visualization results will then be compared to predictions obtained from 2-D numerical simulation conducted using Flo++, a commercial PC-based computational fluid dynamics software package by Softflo.

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EXPERIMENTAL AND NUMERICAL ANALYSIS OF A CROSSFLOW FAN

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ABSTRACT

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I. INTRODUCTION

A. OVERVIEW

As the world population increases, road congestion will become increasingly prevalent. It is commonly believed that there will be a demand for personal air vehicles in the near future. Hence a vehicle that can take off and land vertically is envisioned to solve this problem by utilizing the enormous air space above us. By using the air space, a new type of transportation can be created that doesn't rely on roads, which could one day make traffic jams a 20th century relic. In the past, airplanes and automobiles have changed the way we all live one way or another. The advancement of technology has made vehicles more affordable for the general population to travel in. They also allowed the population to move farther away from cities, and airplanes have cut travel time to faraway destinations considerably. Now the next milestone of the 21st century is to merge the features of an automobile and an airplane, in short what is needed is a flying automobile.

In line with this vision, NASA's General Aviation Program (GAP) aims to provide doorstep to destination travel at four times the speed of highways to 25 percent of the nation's suburban, rural, and remote communities by 2007 and more than 90 percent by 2022. To accomplish this goal NASA have invested in the revolutionary technologies necessary not only to build the next generation of vehicles for business and personal air transportation but also to train the average person to safely operate them. To bring this type of transportation capability to the average person, the vehicles must be **easier and safer to operate** and the related training simplified and reduced in cost (both in time and money). Follow-on investments are now being made to create the infrastructure, referred to as the Small Aircraft Transportation System, which are also necessary for reaching NASA's goals [Ref. 1].

One such program that supports NASA's GAP is the development of civil alternatives to private ground transport; the intent being to reduce ground traffic by replacing the private automobile with a similarly-sized and purposed vertical takeoff and landing (VTOL) vehicle. This would serve the purpose of reducing ground traffic without requiring runways. Some might argue that there are already many VTOL aircraft

flying in the form of helicopters, which obtain their vertical lift from the thrust of large rotors, and utilize the horizontal force for forward speed from the horizontal component of the rotor thrust. Due to the way a helicopter obtains its horizontal thrust, the speed is limited. It is hence desirable for a VTOL aircraft to achieve what the helicopter lags in terms of speed. Another disadvantage of helicopter is the higher risk for potential property and body damage due to close proximity operations. Likewise, jet engines could create a serious fire, noise, and foreign object debris hazard when used outside the controlled atmosphere of the conventional runway. It also has the additional drawback of being prohibitively expensive to purchase and maintain in relation to the automobile's internal combustion engine. Hence, it is desirable to have VTOL designs that do not incorporate exposed nor hazardous propulsion systems but are still able to satisfy the high lift and flight performance requirement.

The main objective of this thesis is hence targeted at evaluating one such device, the Crossflow Fan (CFF), to determine an optimal configuration that is suitable for this purpose. CFFs have been investigated in the past but not sufficient to justify its capability to provide enough vertical thrust with limited power and space. Despite an in-depth knowledge of the design parameters and airflow relationships in the crossflow fan, the existing data supports the hypothesis that with further development the thrust efficiency and thrust to weight ratio could improve to a point where this thrust producing method is viable.

Experiments were conducted using the existing Crossflow Fan Test Assembly (CFTA) which was established at the Naval Postgraduate School Turbopropulsion Laboratory [Ref. 5]. In the present study, the 30-blade, 12 inch diameter and 1.5 inch span CFF was used to determine the performance characteristics at speeds varying from 1,000 RPM to 6,000 RPM. At each of the speeds measurements taken from full open throttle to stall. Studies of different cavity configurations for the CFTA were also made.

A commercial PC-based computational fluid dynamics software package by Softflo Flo++, was used to conduct a 2-D numerical simulation on the CFF. The main aim is to represent the numerical model as close to the actual CFTA. The results obtained from the numerical runs are compared to those obtained from experiment.

B. BACKGROUND

The design of Vertical and Short Takeoff (V/STOL) aircraft encompasses a broad and diverse range of complex engineering problems. Research and development of V/STOL aircraft have produced a bewildering variety of configurations, as illustrated in Figure 1, a summary compiled in 1977 which includes only vehicles with V/STOL capabilities. The most challenging task of designing a successful V/STOL aircraft is to conceive of a configuration that can achieve optimal thrust to weight ratio and thrust to power (i.e. efficiency) [Ref. 2].

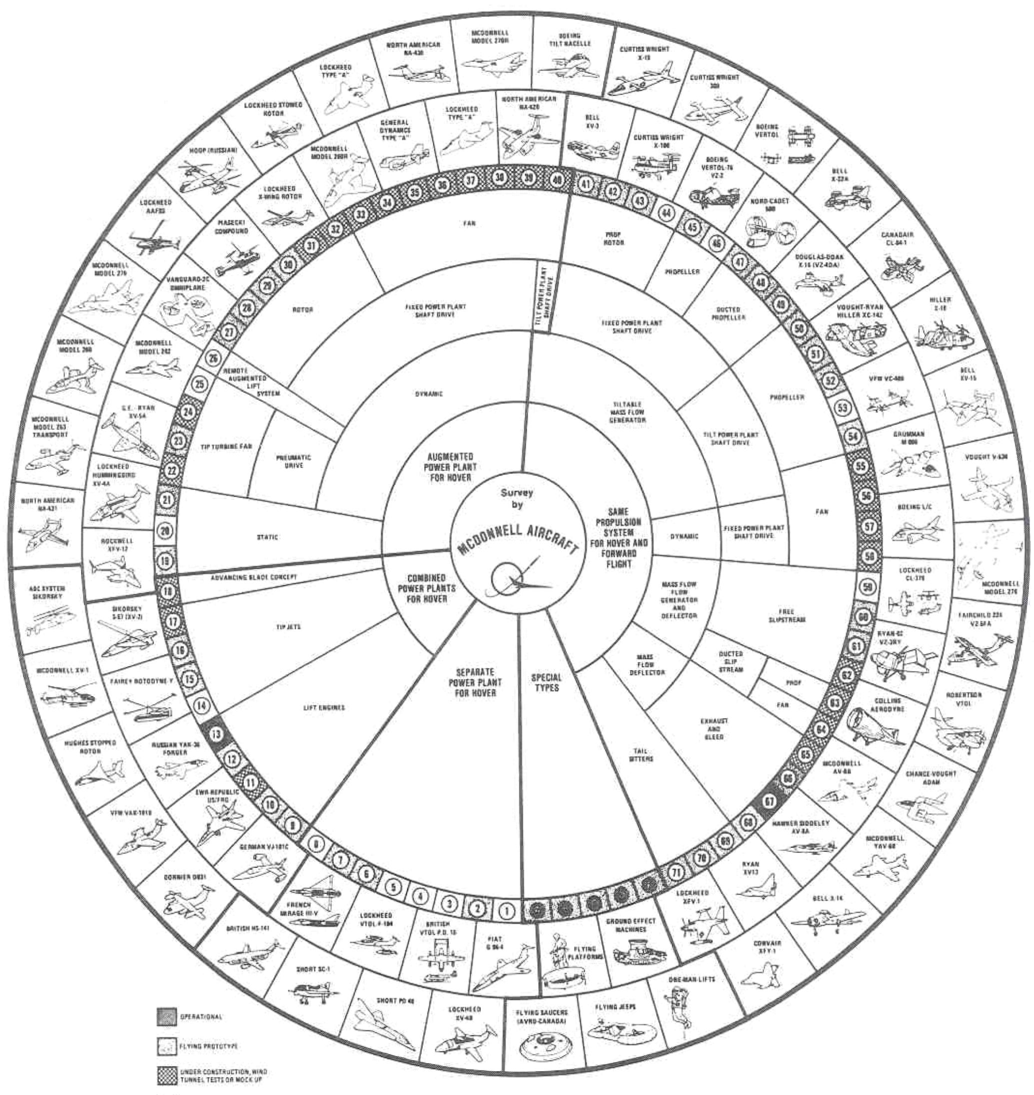

Figure 1. V/STOL Aircraft Summary (From Ref. 2)

One of the possible propulsion systems for V/STOL aircrafts is a CFF. Back in 1975, Vought Systems Division (VSD) (a division of the LTV Aerospace Corporation) was awarded a 12 month contract “Multi-Bypass Ratio Propulsion System Technology Development” by the Naval Air Systems Command [Ref. 3]. The main objectives were to verify the performance capabilities of the Multi-Bypass Ratio (MBPR) Propulsion System through additional tests of the CFF and to conduct studies of the fan structure and fan system. VSD designed, constructed and tested a CFF measuring 12 inches in diameter and both 1.5 inches and 12 inches in span between 6,000 and 13,000 RPM in order to establish baseline performance. Several configurations of a typical setup as shown in Fig. 2 [Ref. 3], which included varying the shape of the low and high cavities, different blade designs and the different area of the exhaust outlet, were used to measure the performance of the CFF. The cavities were used to influence the recirculation flow vortices while the ratio of the fan inner to outer radius also greatly affected the performance. Even though extensive tests had been conducted for several configurations, the optimal design parameters were too complex to be determined. In this project, the experimental setup of the CFF was modeled after one of the most optimal configurations determined by VSD.

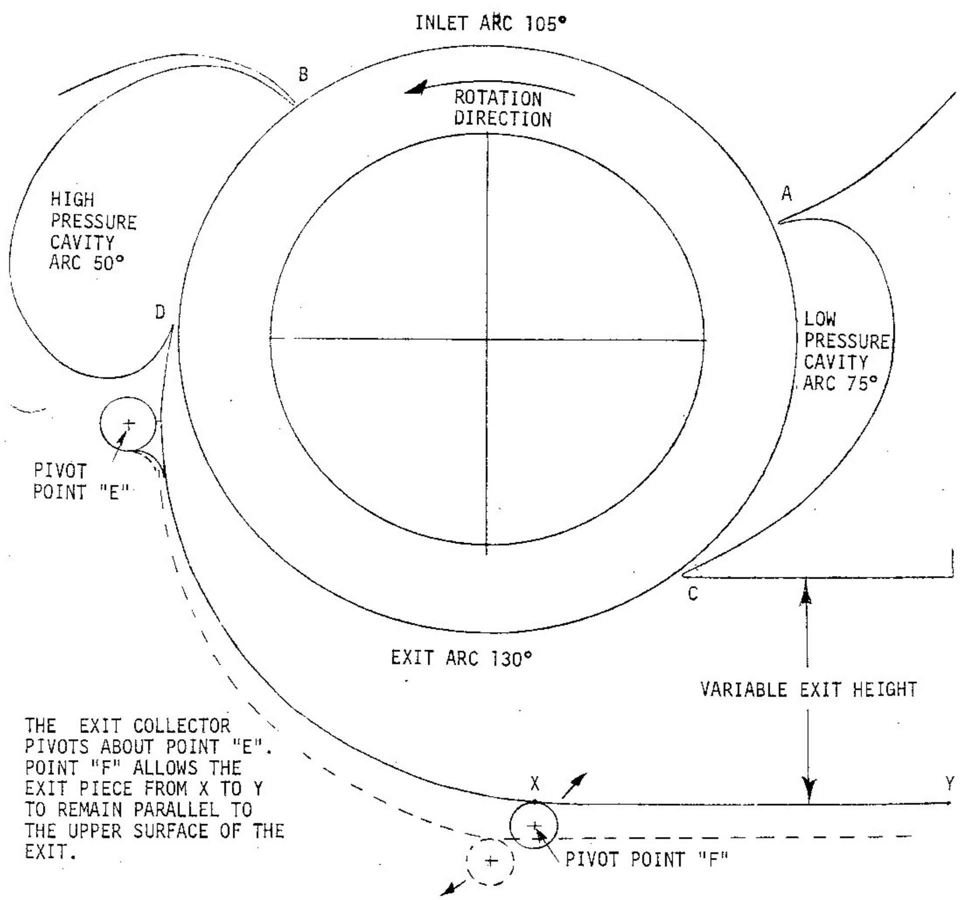

Figure 2. Typical Fan Housing Setup (From Ref. 3)

In line with NASA's interest, Naval Postgraduate School (NPS) Aeronautical Turbomachinery Laboratory was tasked to pursue the CFF in more detail. A thesis was written based on evaluating the performance of the CFF, similar to that from VSD, through experiments as well as numerical simulation [Ref. 5]. A speed range of 1,000 to 6,000 RPM was covered in the experiment. Results were comparable to those measured by VSD. The highest thrust-to-power ratio was obtained at 3,000 RPM. Flow visualization was also conducted using dye-injection methods. The results from the experiment were then compared to predictions obtained form a 2D numerical simulation by Flo++. Seaton [Ref. 5] was only able to model a 15 bladed rotor and an incompressible solution was achieved at a fan speed of 3,000 RPM in a reasonable computational time. The flow fields and performance parameters predicted were similar to those obtained from the experiments.

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II. EXPERIMENT SETUP AND RESULTS

A. CROSSFLOW FAN DESIGN AND SETUP

1. Test Rig

The Turbine Test Rig (TTR) at the Naval Postgraduate School Turboproplusion Laboratory was used as a power source for the Crossflow Fan Test Assembly (CFTA). The TTR comprised of an air supply system and associated piping, test cell, data acquisition system, and the turbine from Space Shuttle Main Engine HP Fuel Turbopump (SSME HPFTP). The air supply system consisted of a 1,250 horsepower (HP) electric motor which drove an Allis Chalmers 12 stage axial compressor at 12,000 RPM through a gearbox. The compressor was capable of providing 10,000cubic feet per minute of air at a maximum pressure of 30psig. A schematic of the air supply system is shown in Figure 3.

2. Crossflow Fan

The CFTA was modeled closely after VSD Multi-Bypass Ratio System test assembly #6 [Ref. 3]. The initial set of tests was conducted using the standard CFTA configuration as described in [Ref. 5] and the second set of tests was done with the addition of an in inlet bellmouth and exhaust ducting with a throttle valve at the exit. The inlet bellmouth had a two-to-one elliptic section with a throat diameter of 6.25 inch and the exhaust was constructed out of a PVC pipe and throttling valve.

The fan rotor was assembled from a machined disc with 30 rotor blades and a retaining ring as shown in Figure 4. The rotor disc was then secured to the drive shaft via three countersunk screws.

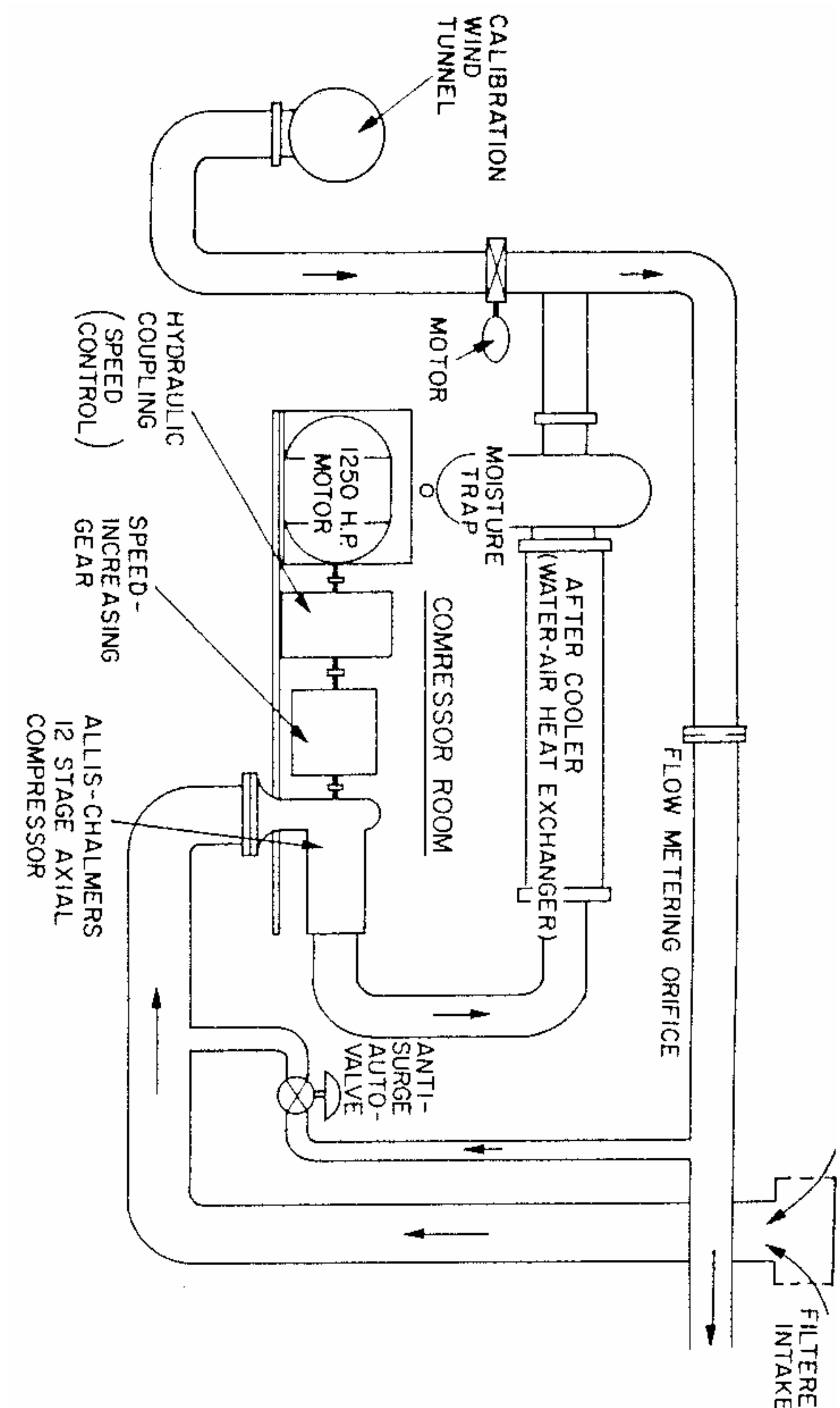

Figure 3. Schematic Layout of Air Supply System (From Ref. 5)

Figure 4. Fan Rotor (From Ref. 5)

The CFTA front plate provided for the replacement of the aluminum plate with a Plexiglas viewing window. Both the options contained inner blanks that could be rotated to provide for alternate positioning of pressure/temperature probes and/or dye injectors. The cavity components and exhaust duct wall were secured in place between the CFTA front and back plates. Figure 5 shows the partially assembled CFTA and Figure 6 shows the complete standard baseline assembly used for the initial setup of tests.

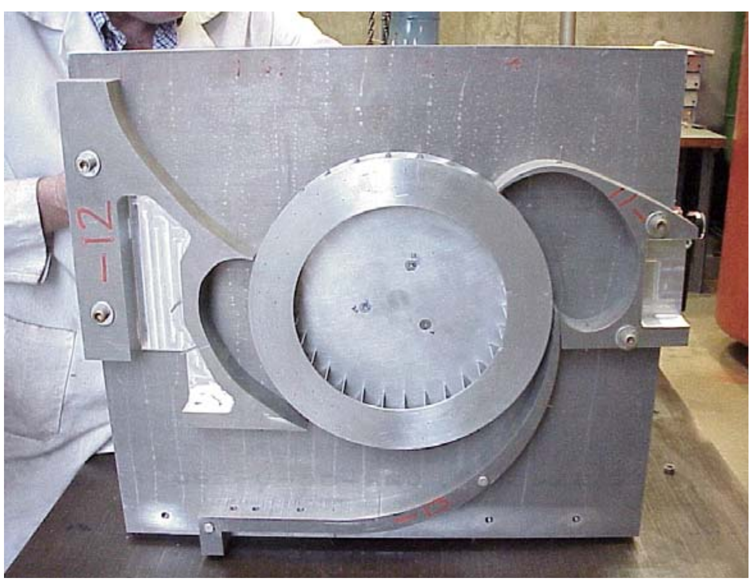

Figure 5. Partially Assembled CFTA (From Ref. 5)

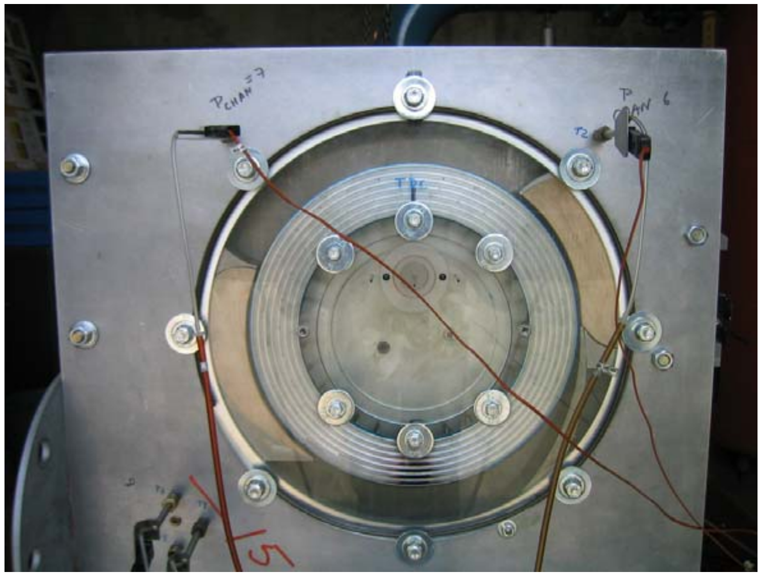

Figure 6.   CFTA1 for Test Plan 1

For the second set of tests conducted, a bellmouth was bolted to a wood and aluminum plenum chamber which was constructed around the inlet of the CFF as shown in Figure 7. The purpose of the bellmouth was to meter the air mass flow rate into the system. Three static pressure taps were placed around the throat of the bellmouth in order to measure static pressure which in turn was used to calculate mass flow rate. The exhaust outlet was extended with a 6.25 inch diameter, 25 inch long PVC pipe. A throttle control, as shown in Figure 7, was installed at the end of the PVC pipe. The main purpose of this throttle was to vary the mass flow rate and hence the other performance parameters in order to obtain the characteristic curves of the CFF at different speeds.

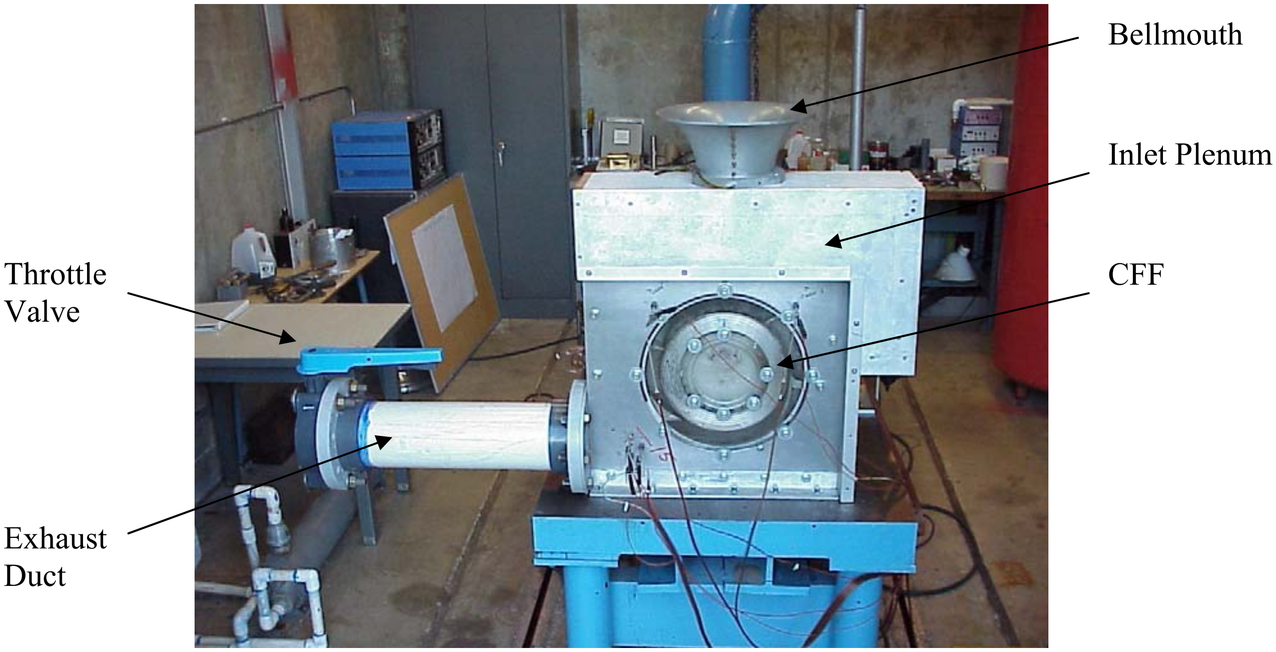

Figure 7. CFTA2 for Test Plan 2

B. CONTROLS AND INSTRUMENTATION

The TTR and CFTA were operated from the control station as shown in Figure 8. The air flow to the turbine was controlled from the operator's console by activating an electric valve in the test cell. Two thermocouples were used to measure the bearing temperatures to ensure that they don't overheat and hence causing seizure. Two accelerometers were also used to monitor the vibration levels on the TTR and CFTA.

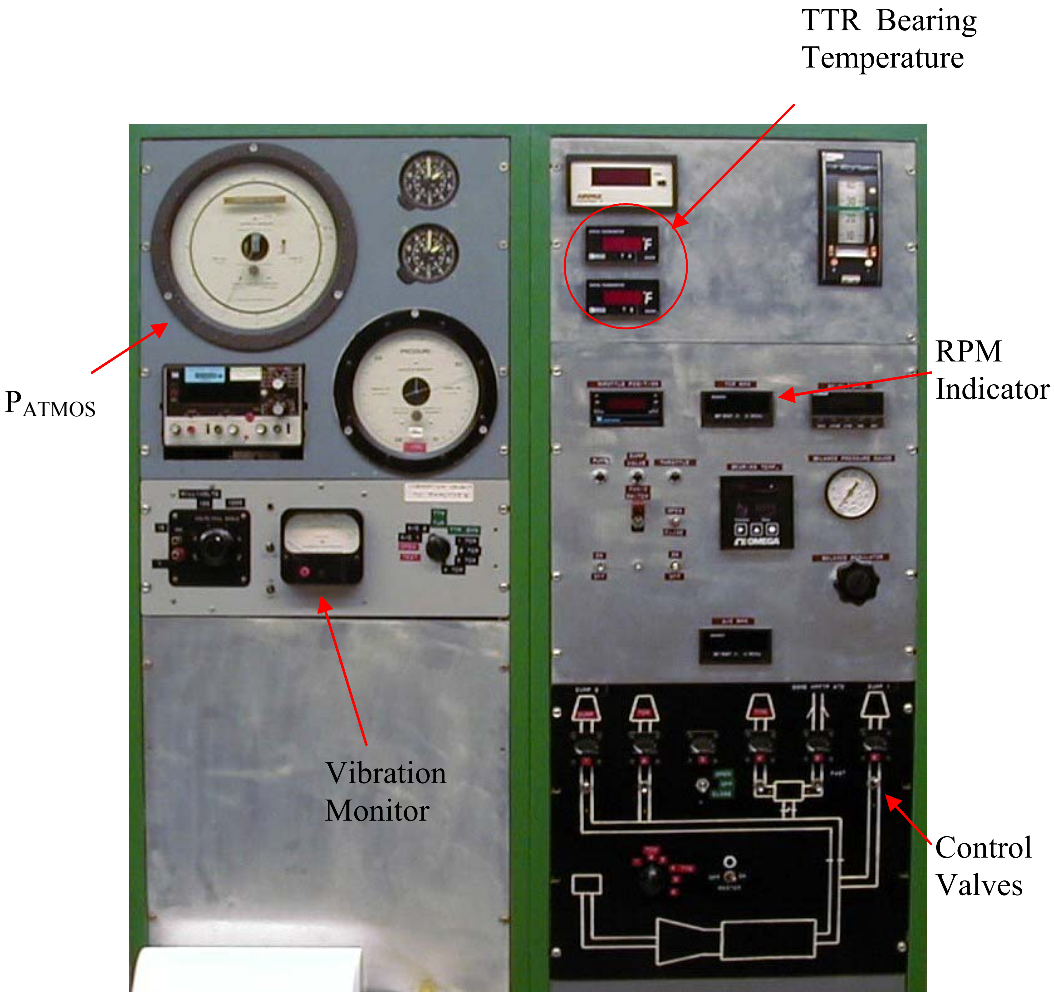

Figure 8. Control Station (From Ref. 5)

Instrumentation for data collection consisted of several combination pressure/thermocouple probes and static pressure taps to capture the information for data reduction.

Three static pressure probes were installed around the neck of the bellmouth, which was used in the final set of tests, as shown in Figure 9 and known as Pnoz1, Pnoz2 and Pnoz3. Two combination probes were placed at approximately 10 o'clock and 2 o'clock positions viewed from the front as shown in Figure 9 known as T1 and T2. Three combination probes, as shown in Figure 11 and known as T3, T4 and T5, were installed in the exhaust duct to detect the total pressure and temperature profiles along the centerline of the exit. The 12 inch diameter static pressure taps (P_A through P_L in Figure

9) were drilled normally into the cavities and exhaust duct walls.. Instrument nonmenclature is provided in Table 1.

Probe/Tap	Type	Nomenclature
T1	Combo	P_{in} CFF / T_{in} CFF (10) o'clock)
T2	Combo	P_{in} CFF / T_{in} CFF (2) o'clock)
T3	Combo	P_{out} CFF / T_{out} CFF (Top)
T4	Combo	P_{out} CFF / T_{out} CFF (Mid)
T5	Combo	P_{out} CFF / T_{out} CFF (Bot)
T6	Combo	P_{noz} 1 CFF at neck of bellmouth
T7	Combo	P_{noz} 2 CFF at neck of bellmouth
T8	Combo	P_{noz} 3 CFF at neck of bellmouth
A	Static	P_A
B	Static	P_B
C	Static	P_C
D	Static	P_D
E	Static	P_E
F	Static	P_F
G	Static	P_G
H	Static	P_H
I	Static	P_I
J	Static	P_J
K	Static	P_K
L	Static	P_L

Table 1. Combo Probe / Pressure Tap Nonmenclature

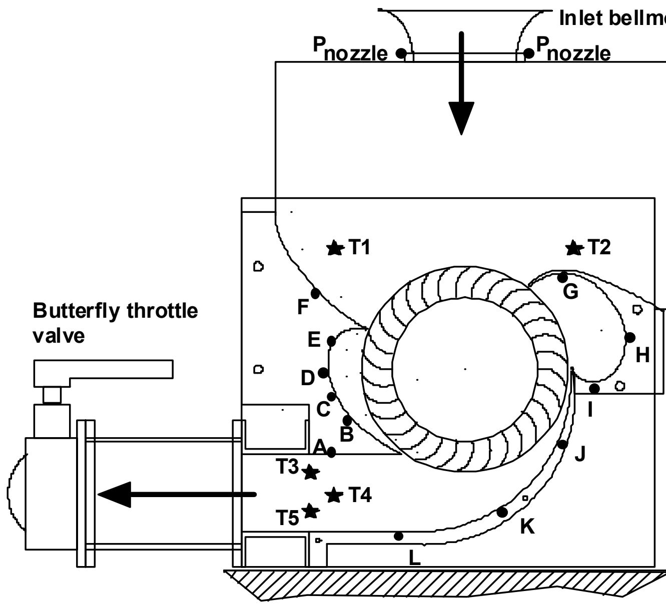

Figure 9. Combo Probes and Pressure Taps Layout

C. DATA ACQUISITION SYSTEM

1. Hardware

A full description of the data acquisition system can be found in [Ref. 5]. The system hardware layout is shown in Figure 10. Table 2 lists the Scanivalve port assignments for the pressure lines and Table 3 lists the thermocouple multiplexer channel assignments for thermocouple lines.

Port #	Type	Nomenclature
1	Static	P_{ATMOS}
2	Static	P_{CAL}
3	Total	P_{in}TTR (5 o'clock)
4	Total	P_{out}TTR
5	Total	P_{in}TTR (8 o'clock)
6	Total	P_{in}CFF (2 o'clock)
7	Total	P_{in}CFF (10 o'clock)
8	Total	P_{out}CFF (Top)
9	Total	P_{out}CFF (Mid)
10	Total	P_{out}CFF (Bot)
11	Static	P_A
12	Static	P_B
13	Static	P_C
14	Static	P_D
15	Static	P_E
16	Static	P_F
17	Static	P_G
18	Static	P_H
19	Static	P_I
20	Static	P_J
21	Static	P_K
22	Static	P_L
24	Static	$P_{noz}1$
25	Static	$P_{noz}2$
26	Static	$P_{noz}3$
32	Static	P_{in}
33	Static	P_{in}(Flange)
34	Static	P_{out}(Flange)
35	Static	P_{out}(Vena)

Table 2. Scanivalve Port Assignments

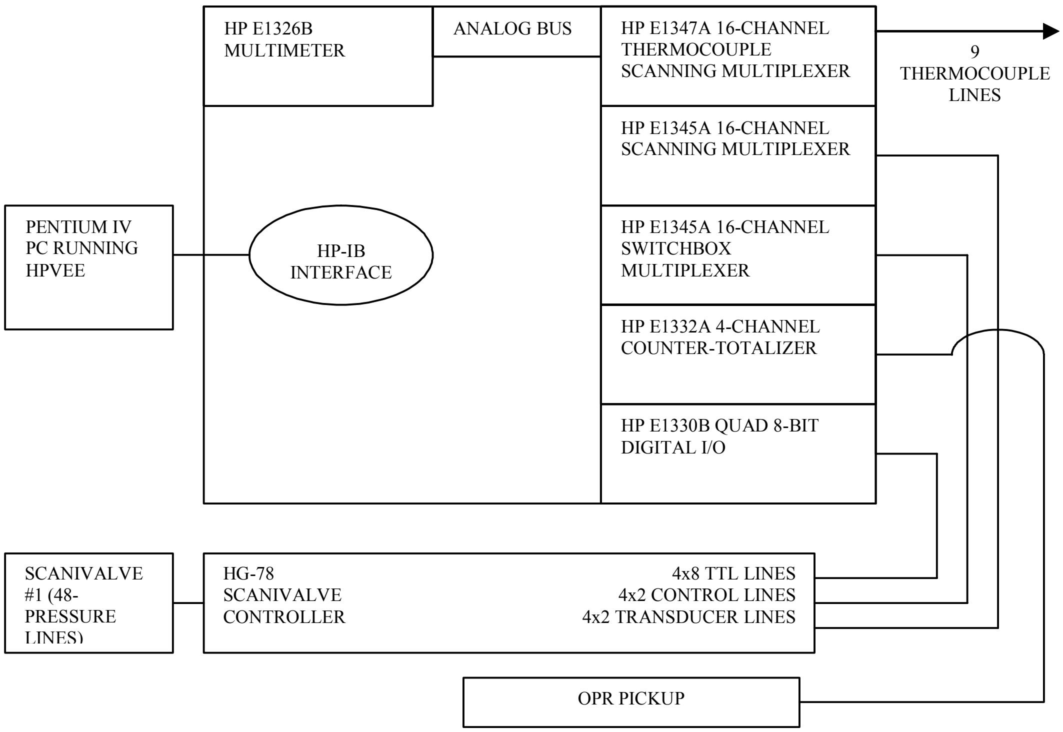

Figure 10. Data Acquisition System Layout (From Ref. 5)

Multiplexer Channel	**Nomenclature**
6	T_{in}CFF (2 o'clock)
8	T_{in}CFF (10 o'clock)
9	T_{in}TTR (8 o'clock)
10	T_{in}TTR (5 o'clock)
11	T_{out}TTR
12	T_{in}Orifice
13	T_{out}CFF (Bot)
14	T_{out}CFF (Mid)
15	T_{out}CFF (Top)

Table 3. Thermocouple Scanning Multiplexer Channel Assignments (From Ref. 5)

2. Software

The data obtained from all the probes were recorded by a software program written in HPVEE. A routine was created in [Ref. 5] and used to capture, calculate and output all the parameters required to study the CFF performance. An example of the User Control Panel is shown in Figure 11.

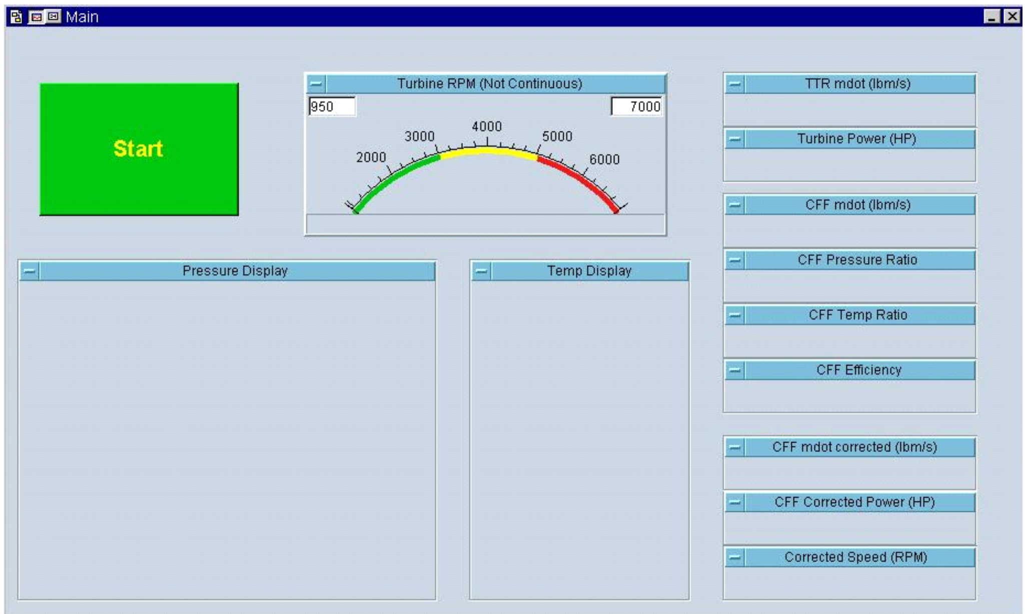

Figure 11. HPVEE User Control Panel (From Ref. 5)

D. TEST PLAN

1. Test Plan 1 – Baseline Configurations

The test assembly used for these tests was shown in Figure 6. Four configurations were chosen for evaluation, which was a similar setup used in [Ref. 5]. The four configurations tested were a permutation between opening and closing the low pressure (LP) and high pressure (HP) cavities. The main objective was to understand the difference in performance between the four configurations namely;

- Both cavities opened
- Both cavities closed
- LP cavity closed and the HP cavity opened
- HP cavity closed and the LP cavity opened

With these four configurations, the CFF was run at five speeds starting from 1,000 RPM up to 5,000 RPM in 1,000 RPM intervals. Pressure and temperature values were recorded at every speed. Primary data reduction was carried out in the HPVEE acquisition program.

A detailed discussion on the equations used to derive the performance parameters were discussed in [Ref. 5]. Some of the more important equations are as follows:

The total-to-total pressure ratio and temperature ratio for the CFF are given by

$$\pi_{CFF} = \frac{P_{out,CFF(avg)}}{P_{in,CFF(avg)}} \quad \text{and} \quad \tau_{CFF} = \frac{T_{out,CFF(avg)}}{T_{in,CFF(avg)}} \qquad (1)$$

where $P_{out,CFF,(avg)}$ *and* $T_{out,CFF,(avg)}$ are the average total-to-total pressures and temperatures of the three CFF exhaust duct combination probes T3, T4 and T5. $P_{in\ CFF(avg)}$ *and* $T_{in,CFF,(avg)}$ are the average total-to-total pressures and temperatures of the two CFF inlet combination probes T1 and T2.

Compression efficiency through the CFF was calculated from the values found in (1) above, using the isentropic efficiency:

$$\eta_{CFF} = \frac{\pi_{CFF}^{\left(\frac{\gamma-1}{\gamma}\right)} - 1}{\tau_{CFF} - 1} \qquad (2)$$

assuming $\gamma = 1.4$.

CFF performance values were corrected to standard atmospheric conditions, such that:

$$\dot{m}_{corr} = \dot{m}\frac{\sqrt{\theta}}{\delta}, \qquad N_{corr} = \frac{N}{\sqrt{\theta}}, \qquad HP_{corr} = \frac{HP}{\delta\sqrt{\theta}} \qquad (3)$$

where $\dot{m}$ is the mass flow rate in lbm/sec, N is fan speed in RPM, HP is the horse power, $\theta = \frac{T_{in,CFF(avg)}}{T_{ref}}$, and $\delta = \frac{P_{in,CFF(avg)}}{P_{ref}}$. T_{ref} and P_{ref} were standard atmospheric temperature (518.7 °R) and pressure (29.92 inHg), respectively.

2. Test Plan 2 – Throttling Studies

The test assembly used for this test was shown in Figure 7. Two configurations were evaluated. The first configuration had both the LP and HP cavities open (baseline geometry) and the second configuration had both the cavities blanked off.

With these two configurations, the CFF was ran at five speeds starting from 2,000 RPM up to 6,000 RPM in 1,000RPM interval. At every speed, the exhaust throttle was closed slightly to simulate a back pressure on the CFF. A total of eight positions were tested for every speed line. By doing so, the compressor performance map for the CFF could be obtained. Table 4 shows the test matrix for the whole experiment.

Eight Throttling Positions

	Both Cavities Opened	Both Cavities Closed
Fully opened Throttle		
…		
Partially opened Throttle		
…		
Maximum Throttle closure		

2,000RPM
3,000RPM
4,000RPM
5,000RPM
6,000RPM

Table 4. Experimental Test Matrix for Test Plan 2

Seaton [Ref. 5] used the three exit plane combination probes to calculate the mass flow rate through the CFF by integrating the velocity profile obtained by only three measurement points. In the present study, the inlet bellmouth was added to give a more accurate measurement of inlet flow which is one of the standard ways of obtaining mass flow rate.

E. RESULTS AND DISCUSSION

1. Test Plan 1

a. Discussion on Performance Plots

Performance data were plotted and analyzed for the four CFF configurations tested. These plots included total-to-total pressure versus corrected mass flow rate, total-to-total temperature versus corrected mass flow rate, efficiency versus speed, corrected mass average mass flow versus corrected speed, corrected mass averaged power versus speed, thrust versus corrected speed and corrected thrust versus power. The plots were illustrated from Figure 12 to Figure 18.

Figure 12 shows a plot of total-to-total pressure versus corrected mass flow rate for the four configurations tested. We observed that t-t pressure increased at an increasing rate with mass flow rate and other than the both cavities closed configuration, all the other three curves collapsed onto one curve. The highest t-t pressure of 1.17 was achieved at a mass flow rate of 1.8 lbm/s, speed of 5,000 RPM with the both cavities opened configuration. The LP cavity opened, HP cavity closed configuration follows the above mentioned curve closely.

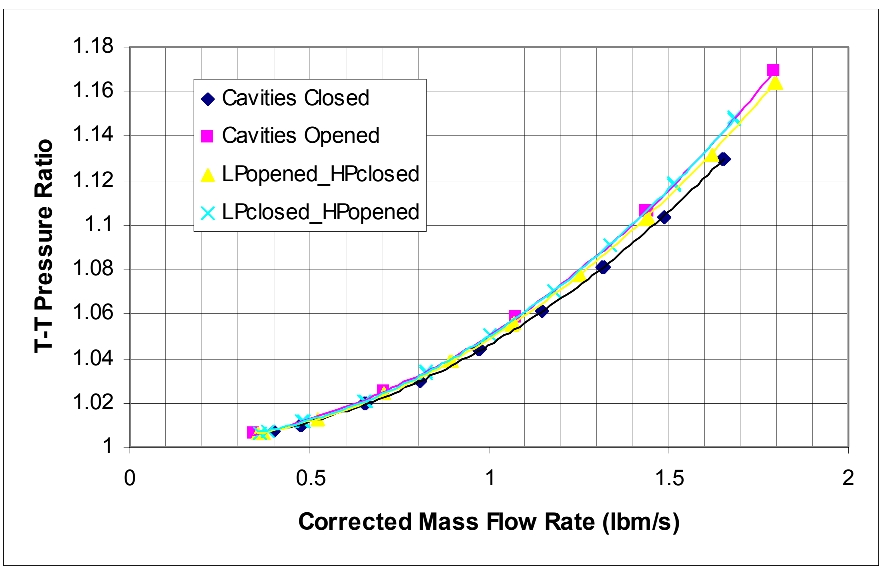

Figure 12. T-T Pressure Ratio versus Corrected Mass Flow Rate

Figure 13 shows a plot of total-to-total temperature versus corrected mass flow rate for the four configurations tested. The trends of the curves are similar to that of Figure 12. Both cavities opened configuration was slightly above the three curves and hence had larger t-t temperature values for the same mass flow rate. And this value was 1.068 achieved at a mass flow rate of 1.8 lbm/s, speed of 5,000 RPM.

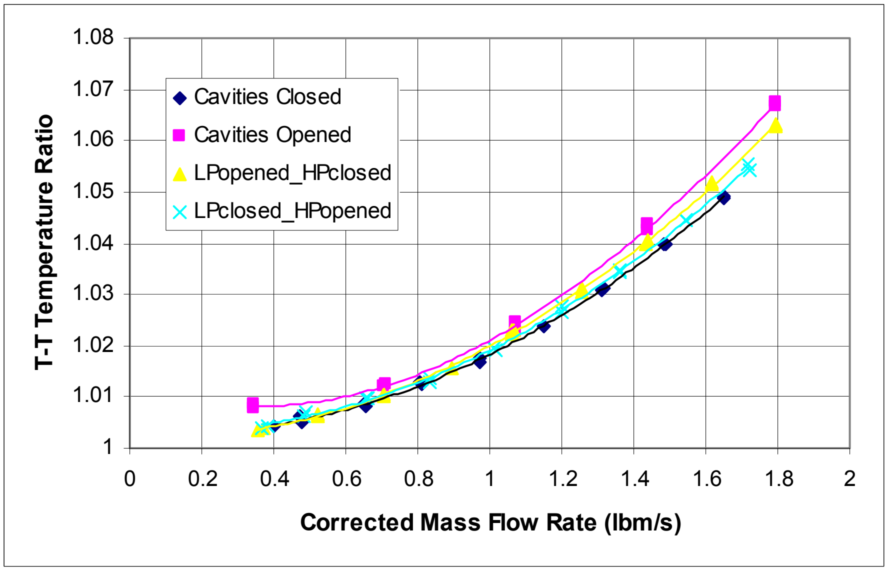

Figure 13. T-T Temperature Ratio versus Corrected Mass Flow Rate

Figure 14 shows a plot of efficiency versus corrected speed for the four configurations tested. The efficiencies were in the region of 66% to 74% for all the four configurations between speeds of 3,000 RPM and 5,000 RPM. The efficiencies dropped drastically when the speed was reduced from 3,000 RPM to 1,000 RPM. The lowest efficiency of 0.22 was seen with the both cavities opened configuration. As discussed before, the t-t temperature ratio for this configuration was higher than the rest. And since t-t temperature ratio has an inverse relation with efficiency, the efficiency for this configuration was the lowest compared to the other configurations. The highest efficiency occurred for the LP cavity closed configuration between speed of 3,000 RPM and 5,000 RPM.

Figure 15 shows a plot of corrected mass flow rate versus corrected speed for the four configurations tested. As expected, the mass flow rate was directly proportional to the speed as shown by the linear curves.

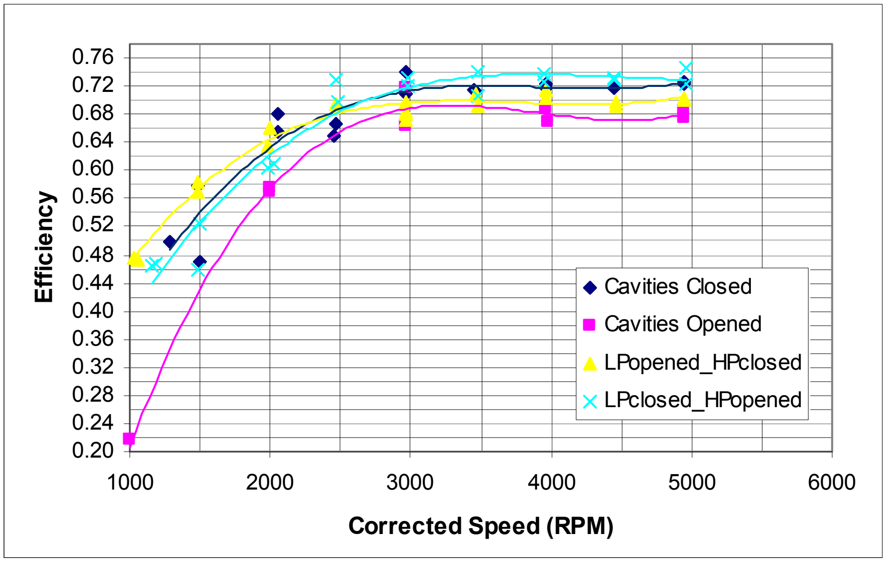

Figure 14. Efficiency versus Corrected Speed

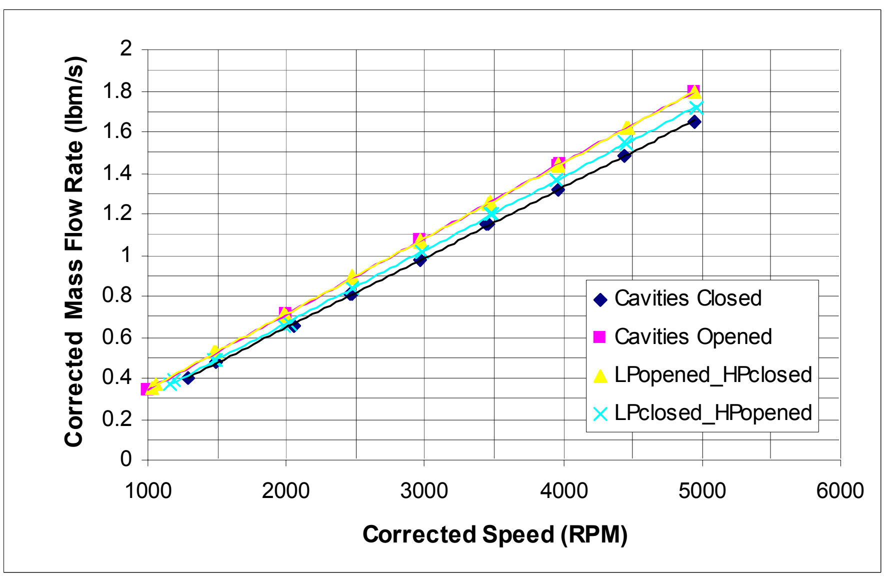

Figure 15. Corrected Mass Flow Rate versus Corrected Speed

Figure 16 shows a plot of corrected mass averaged power versus corrected speed for the four configurations tested. The mass average power increased at an increasing rate with corrected speed for all the configurations. This phenomenon indicated that as the rotor speed was increased to obtain more thrust, the unit power consumption also increased. Hence operating at high rotor speed might not be advisable.

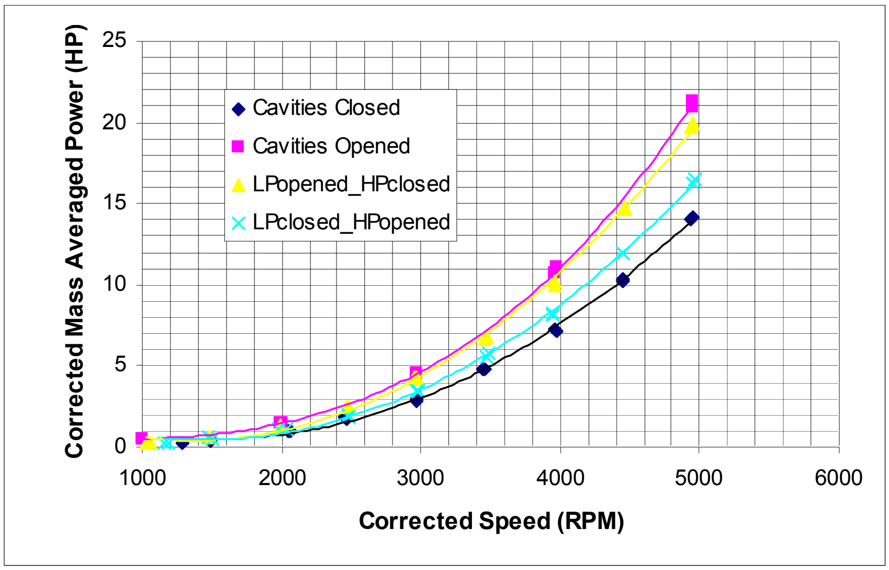

Figure 16. Corrected Mass Averaged Power versus Corrected Speed

Figure 17 shows a plot of corrected thrust per foot span versus corrected speed for the four configurations tested. The maximum thrust occurred at 5,000 RPM for the both cavities opened configuration.

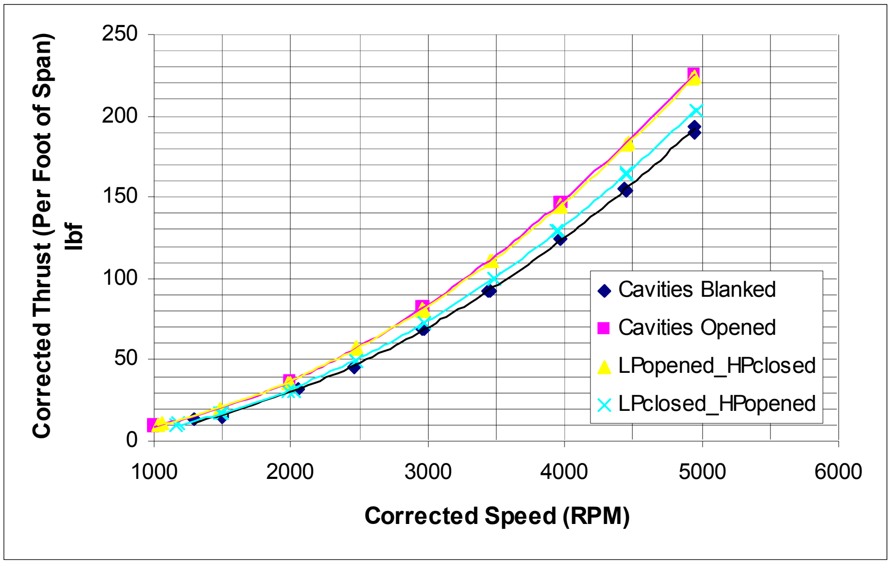

Figure 17. Corrected Thrust versus Corrected Speed

Figure 18 shows a plot of corrected thrust per foot span versus corrected power for the four configurations tested. Other than the both cavities opened configurations curve, the other three curves fall onto the same line. The curves also increased at a decreasing rate and hence suggesting that the amount of thrust obtained per unit power increased with speed. This phenomenon only occurred after 3,000 RPM.

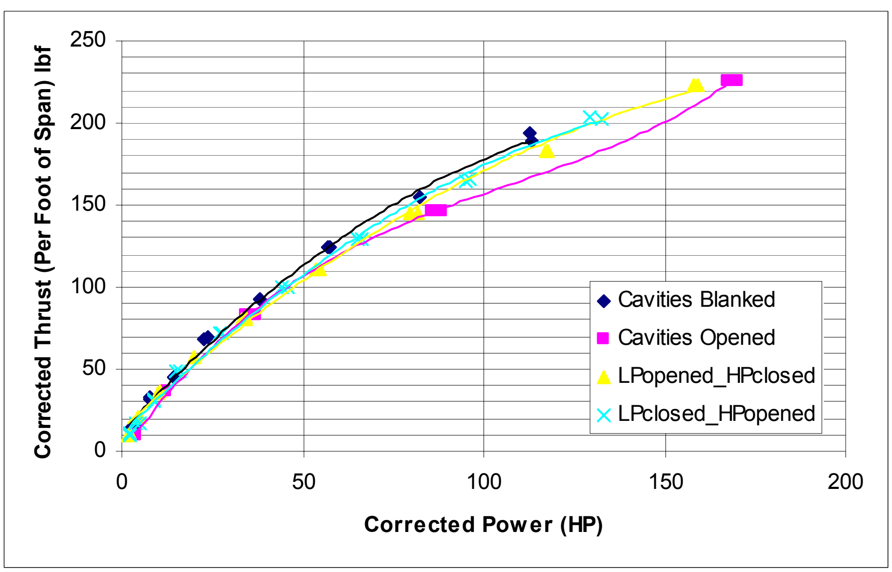

Figure 18. Corrected Thrust versus Corrected Power

b. Flow Visualization

Flow visualization was conducted with the aim of understanding the major flow features in the CFF. In Figure 19, the visualization due to three dyes injected in the left, center, and right ports of the Plexiglas inner blank for the both cavities opened configuration was shown [Ref. 5]. All flow visualization was performed at a rotational speed of 3,000 RPM. The picture shows the re-circulating streamlines inside the fan core and the centre of vortex at the LP cavity. Figure 20 shows the flow visualization for the both cavities closed configuration. The centre of vortex became smaller and its location had shifted downwards compared to that from Figure 19.

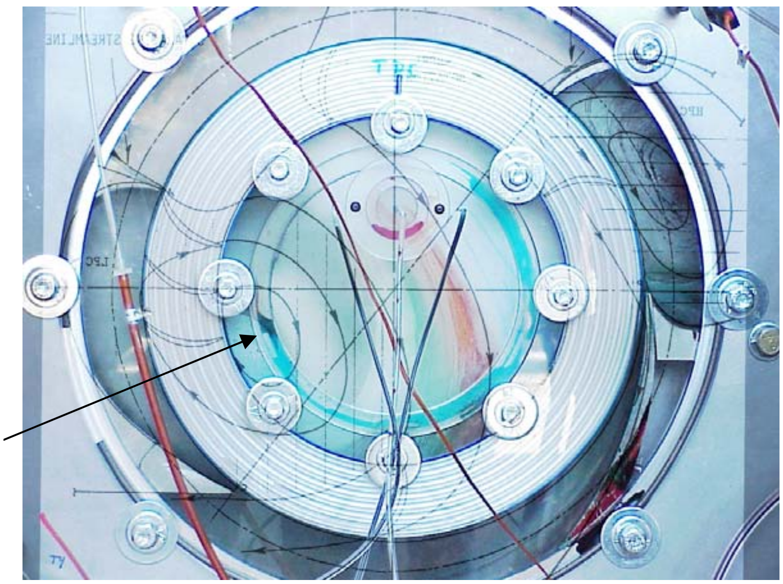

Figure 19. Flow Visualization for Both Cavities Opened Configuration

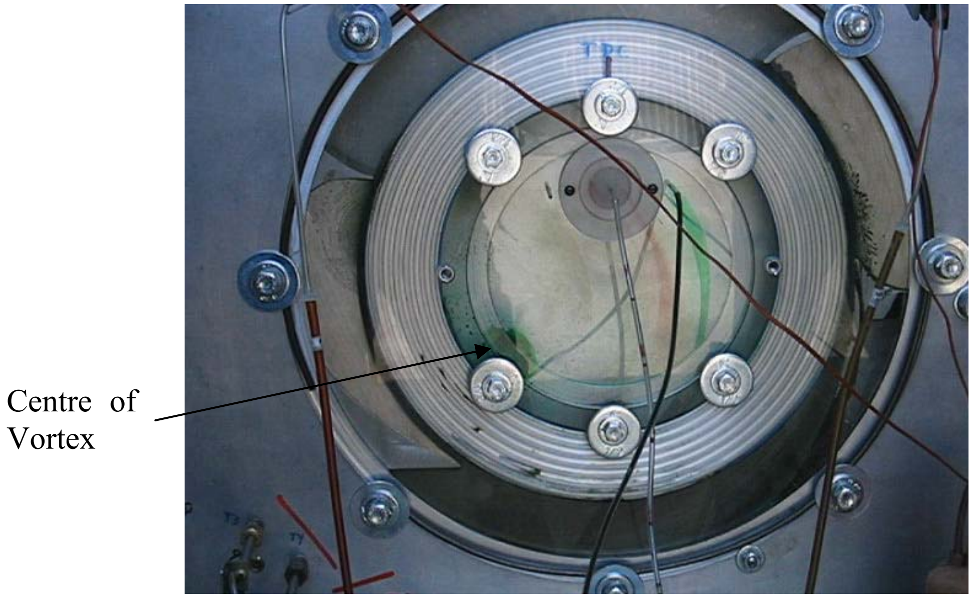

Figure 20. Flow Visualization for Both Cavities Closed Configuration

2. Test Plan 2

a. Discussion of Performance Plots

Performance data were plotted and analyzed for the two CFF configurations tested. These plots included total-to-total pressure versus corrected mass flow rate, total-to-total temperature versus corrected mass flow rate, efficiency versus corrected mass flow rate, corrected thrust per unit foot of span versus corrected mass flow rate, corrected thrust per unit foot of span versus corrected mass averaged horse power (HP) and corrected mass average HP versus corrected mass flow rate. The plots were illustrated from Figure 21 to 32.

Starting from full open on the throttle, for each speed, the total pressure dropped as the mass flow rate was decreased as shown in Figure 21. This characteristic is similar to centrifugal compressors which have forward swept vanes. For the baseline case the characteristic started out relatively flat and then increased in slope as the fan was taken into stall (the last point on the curve). In contrast, the configuration with the cavities blanked off exhibited nearly linear behavior with throttling over the whole speed range tested as shown in Figure 22. This configuration produced a slightly lower peak pressure ratio (1.23 versus1.27) and mass flow rate (2.24lbm/sec versus2.38lbm/sec) at 6,000 RPM than the baseline configuration.

Similarly, the temperature ratio for the baseline configuration as shown in Figure 23 showed a non-linear behavior when compared to the blanked off configuration Figure 24, particularly for the two highest speed lines of 5,000 and 6,000 RPM. Maximum temperature ratios of approximately 1.1 and 1.085 were achieved at mass flow rates of 2.4 lbm/s and 2.25 lbm/s respectively at the 6,000 RPM for baseline configuration and that with both cavities blanked off.

From the efficiency formula (2), which is a function of both pressure and temperature ratios, the efficiency versus corrected mass flow rate plots were obtained as shown in Figure 25 and 26. The sharp increase in temperature ratio across the baseline configuration at stall resulted in a sharp drop in efficiency at stall from a peak value around 70% to below 30% and interestingly all the speed lines tend to converge to the same point. The configuration with the cavities blanked off had a slightly higher peak efficiency in the mid 70% range which did not decrease as noticeably near stall. The drastic drop in efficiency is known to be the stall condition for the CFF. It seemed that the dropped in efficiency during stall was more drastic for the baseline configuration compared to both cavities blanked off as seen from the efficiencies values at the region of 0.6 lbm/s to 0.8 lbm/s. This meant that the baseline configuration was more sensitive to the change in mass flow rate compared to the blanked off configuration.

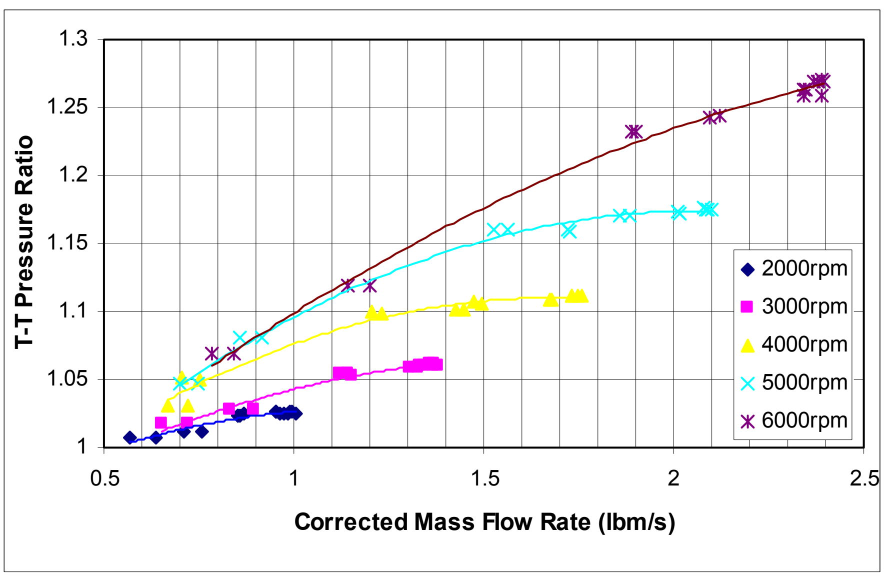

Figure 21. T-T Pressure Ratio versus Corrected Mass Flow Rate for Baseline Geometry

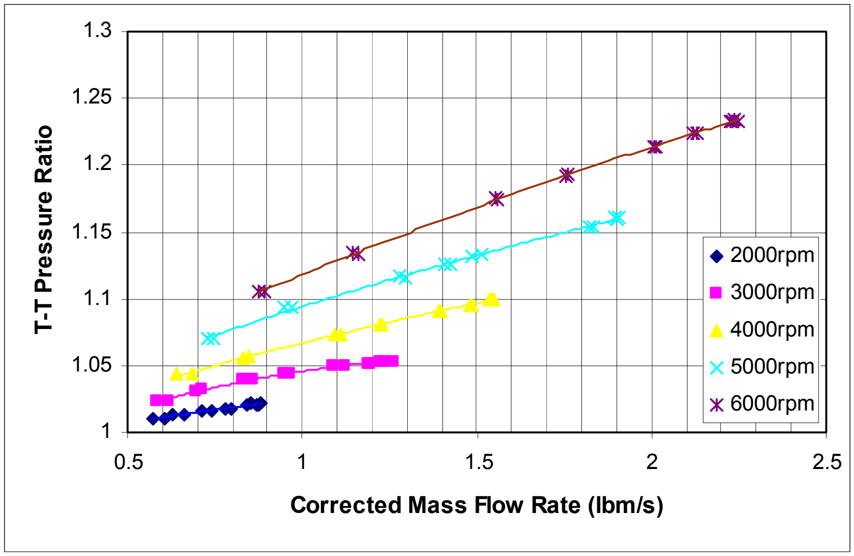

Figure 22. T-T Pressure Ratio versus Corrected Mass Flow Rate of Baseline Geometry for Both Cavities Blanked Off

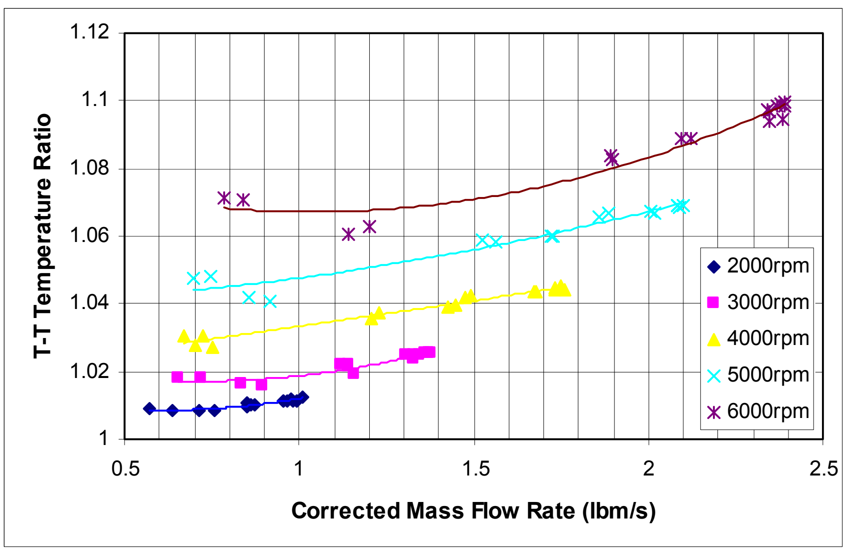

Figure 23. T-T Temperature Ratio versus Corrected Mass Flow Rate for Baseline Geometry

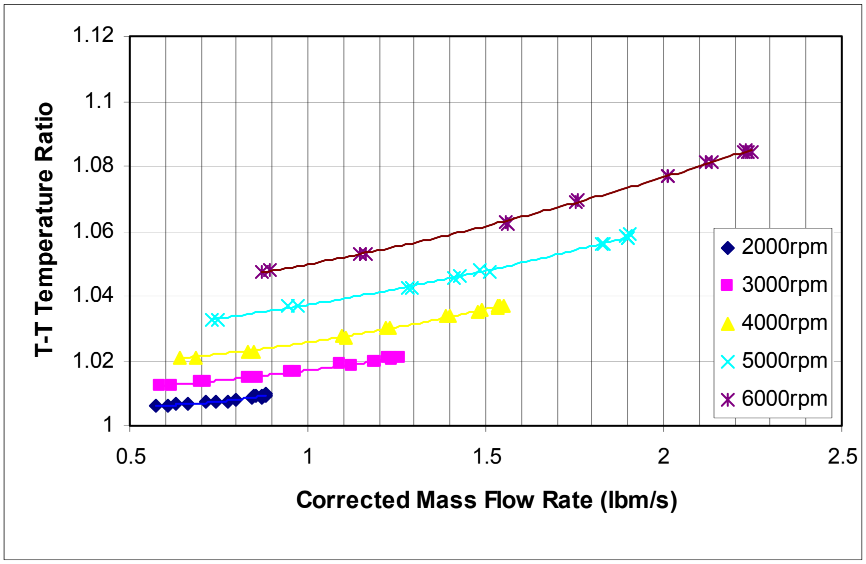

Figure 24. T-T Temperature Ratio versus Corrected Mass Flow Rate of Baseline Geometry for Both Cavities Blanked Off

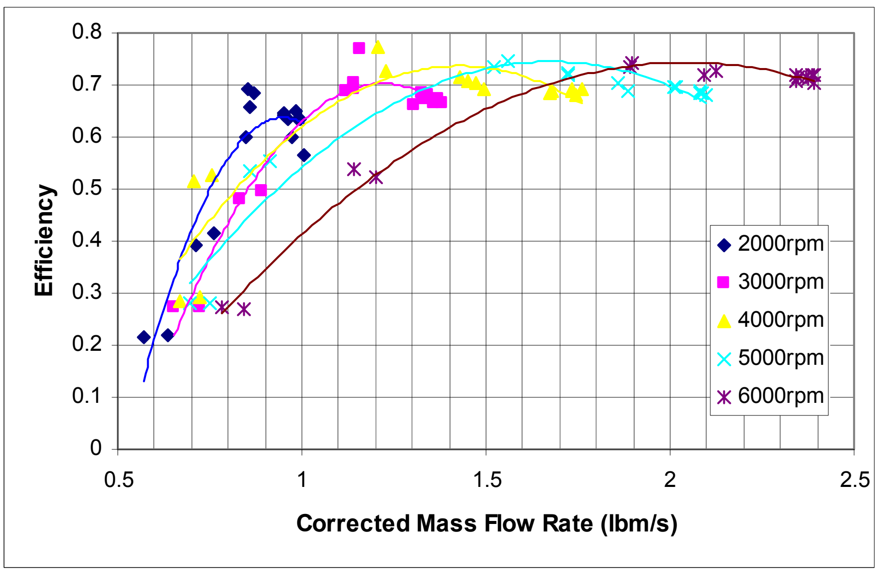

Figure 25. Efficiency versus Corrected Mass Flow Rate for Baseline Geometry

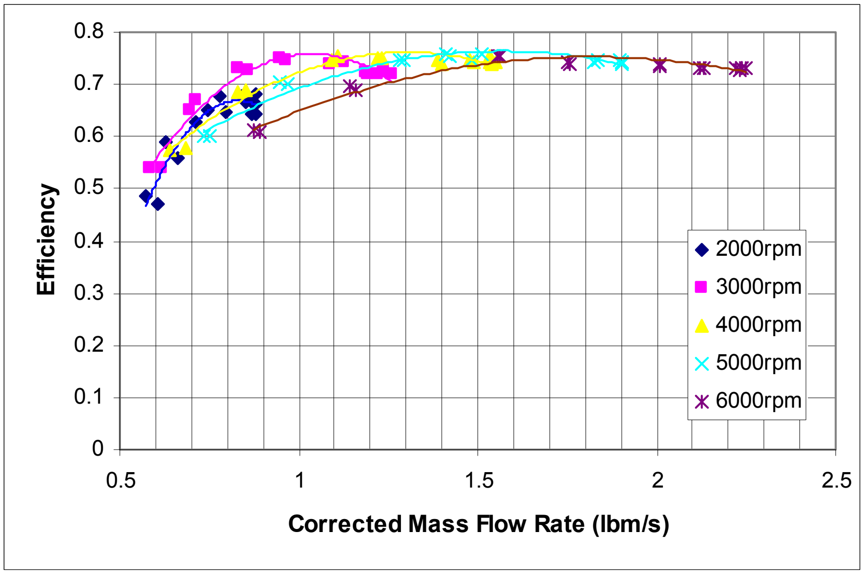

Figure 26. Efficiency versus Corrected Mass Flow Rate for Both Cavities Blanked Off

The thrust per foot span versus mass flow rate plot for the baseline configuration, as shown in Figure 27, almost collapsed onto a single curve, which surprisingly was the case for the configuration with the blanked cavities as shown in Figure 28. This indicated that the same thrust could be obtained with the fan operating at 5,000 RPM at full open throttle versus the rotor turning at 6,000 RPM at partial mass flow rate. However, the 5,000 RPM operation was at a reduced power consumption of 25HP versus 35HP at 6,000 RPM. The maximum thrust per foot span obtained for the baseline configuration was 370lbf at 2.4 lbm/s while the maximum thrust per foot span obtained for both blanked off configuration was 340 lbf at 2.25 lbm/s.

The corrected mass averaged HP versus corrected mass flow rate plots, as shown in Figure 29 and 30, had similar curve profiles as the thrust to mass flow rate plots except that they do not collapse onto a single curve. Peak power consumption obtained for the baseline was 42HP at 2.4lbm/s and the peak power consumption obtained for the configuration with both cavities blanked off was 35HP at 2.25lbm/s.

The thrust per foot span versus corrected mass averaged power is shown in Figure 31 and 32. The maximum thrust-to-power ratio (lbf/hp) for the baseline configuration was 27.3 at 2,000 RPM and open throttle, which decreased to 9.0 at 6,000

RPM. These values were slightly up, 31.2 and 9.9 respectively, for the blanked-off configuration. The conclusion here being that if vertical lift thrust is required for minimum power consumption, then slow rotor operation is required.

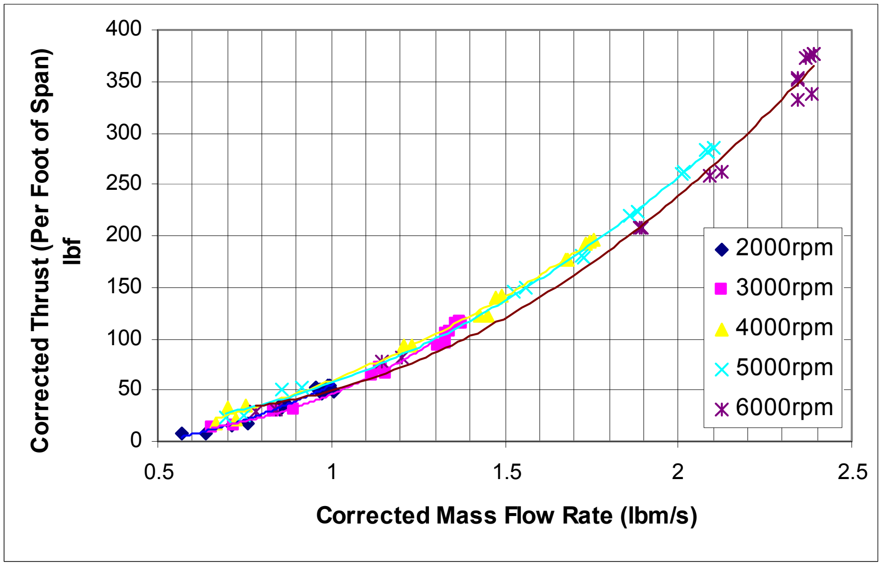

Figure 27. Corrected Thrust versus Corrected Mass Flow Rate for Baseline Geometry

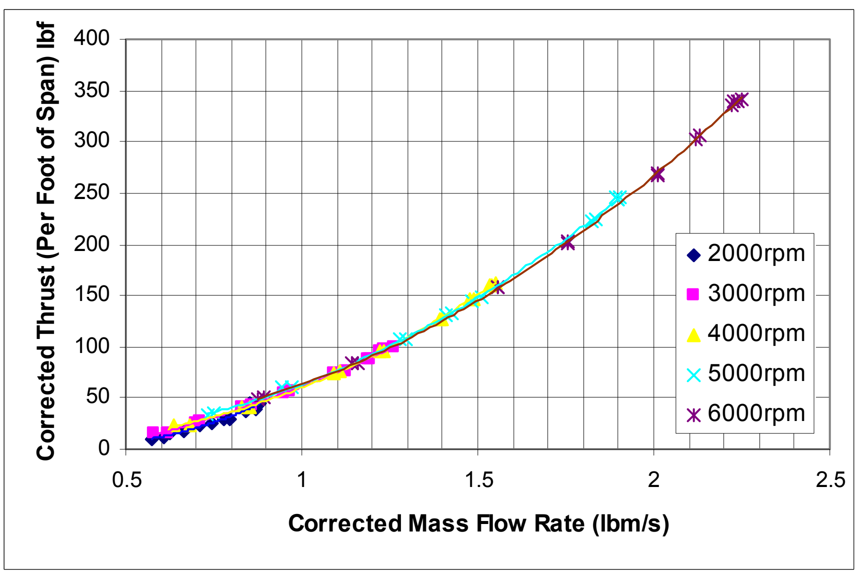

Figure 28. Corrected Thrust versus Corrected Mass Flow Rate for Both Cavities Blanked Off

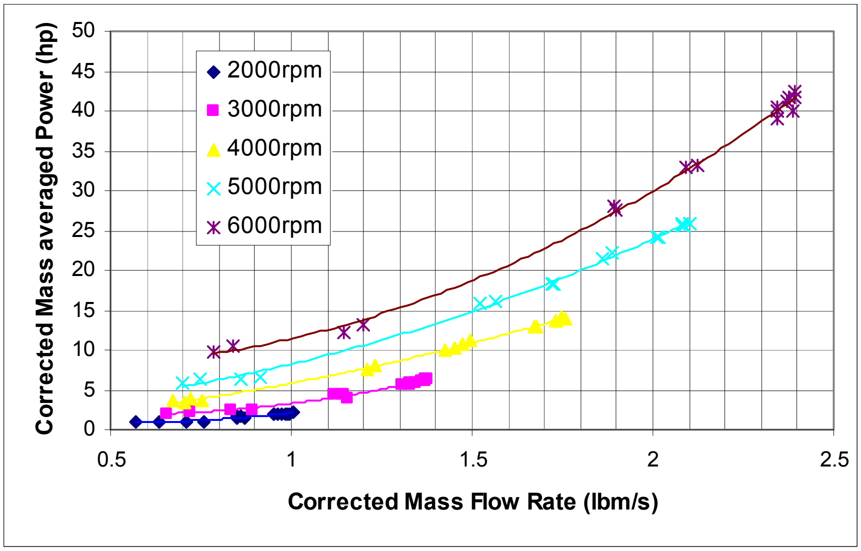

Figure 29. Corrected Mass Average Power versus Corrected Mass Flow Rate for Baseline Geometry

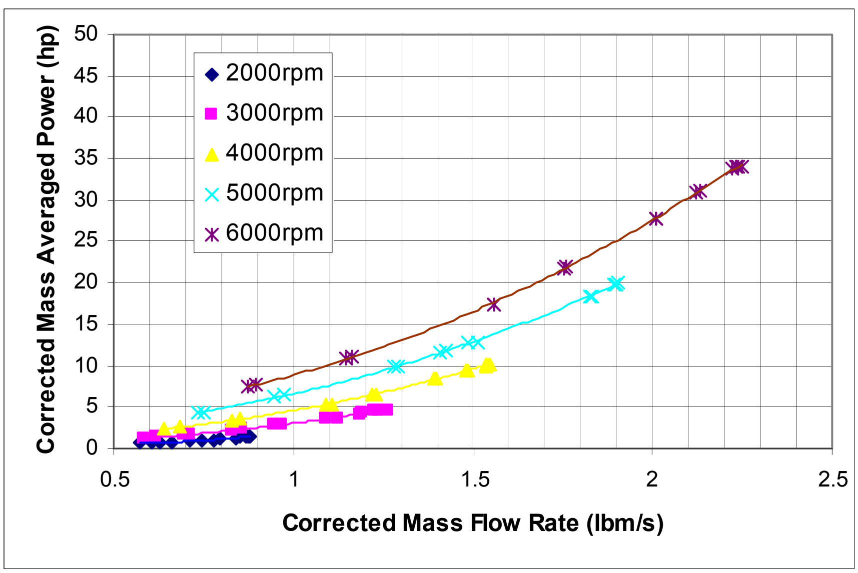

Figure 30. Corrected Mass Average Power versus Corrected Mass Flow Rate for Both Cavities Blanked Off

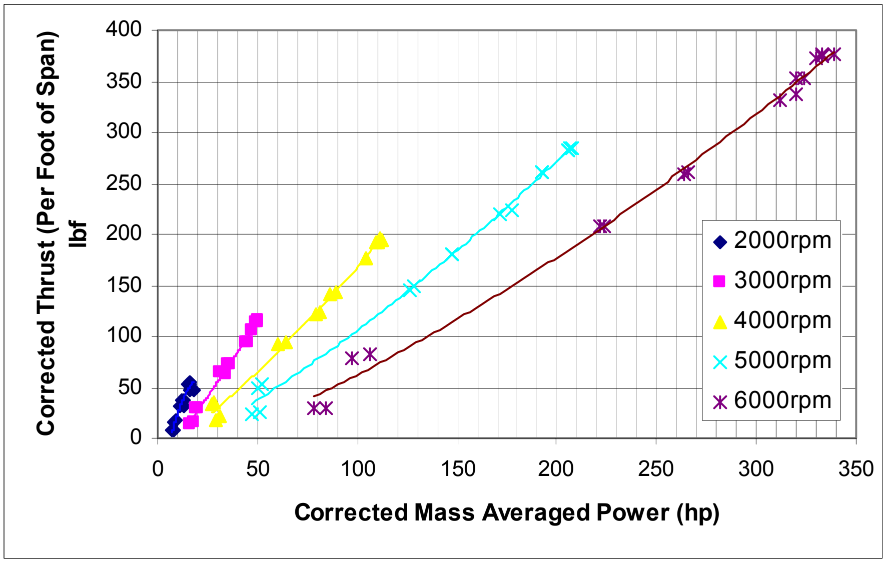

Figure 31. Corrected Thrust versus Corrected Mass Average Power for Baseline Geometry

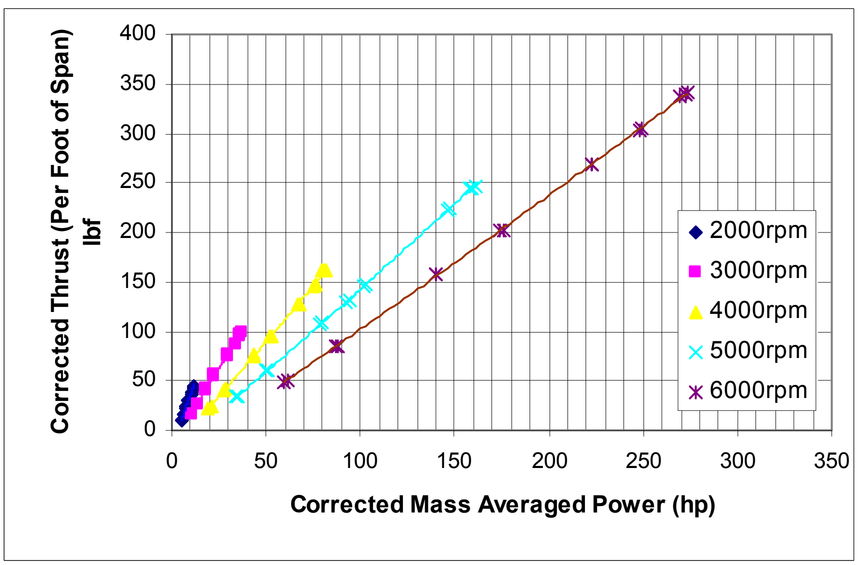

Figure 32. Corrected Thrust versus Corrected Mass Average Power of Baseline Geometry for Both Cavities Blanked Off

b. Flow Visualization for Both Cavities Blanked Off Configuration

It was of interest to understand the changes in flow patterns within the rotor with changes in mass flow. As the flow through the fan was throttled, in this case at 3,000 RPM, the following changes were observed, shown in Figures 33 and 34. At peak efficiency as shown in Figure 33, the streamline through the centre of the rotor were well

behaved i.e. curved towards the exit. There was a small vortex located in the lower left hand portion of the rotor outside the LP cavity. At stall as shown in Figure 34, the extent of the vortex had grown to encompass most of the centre of the rotor. The streamline patterns were also very irregular indicating that the flow was more unsteady.

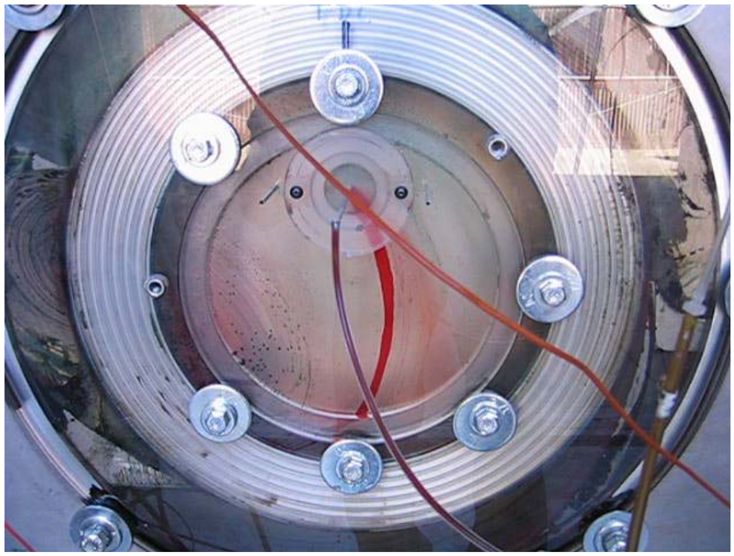

Figure 33. Flow Visualization at Peak Efficiency at 3,000 RPM

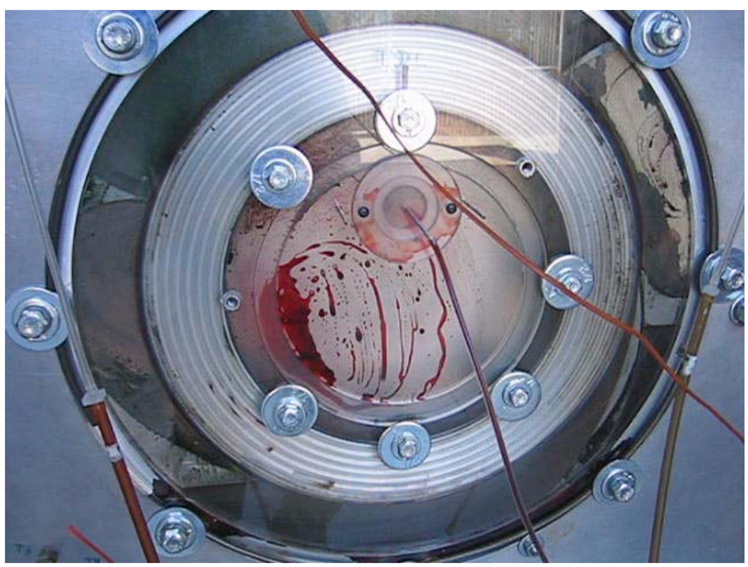

Figure 34. Flow Visualization at Stall at 3,000 RPM

III. NUMERICAL SIMULATION

A. CROSSFLOW FAN DESIGN AND SETUP

1. Overview

A commercial PC-based computational fluid dynamics software package Flo++ developed by Softflo, was used to conduct a 2-D numerical simulation on the CFF. The 0.305 m (12 inch) diameter and 30 bladed CFF, similar to that used during the experimental program, was modeled and ran at a speed of 3000 RPM. Incompressible and turbulent flow using a time marching upwind differencing modified PISO algorithm was used to solve the unsteady flow through the CFF. For turbulent flow calculations the high Reynolds number k-ε model was incorporated. Sliding meshes were used to model moving or rotating boundaries.

2. Grid Generation and Boundary Conditions

Grid generation for the CFF model was initiated with a Matlab code to generate the coordinates of the blade profile as shown in Figure 35. After which the coordinates text file was read into the Flo++ preprocessor and used to create the complete rotor of the CFF. A more detail discussion of the grid can be found in [Ref. 5]. Although Seaton generated a 15 bladed configuration versus a 30 blade configuration in this report, the setup procedure was almost similar.

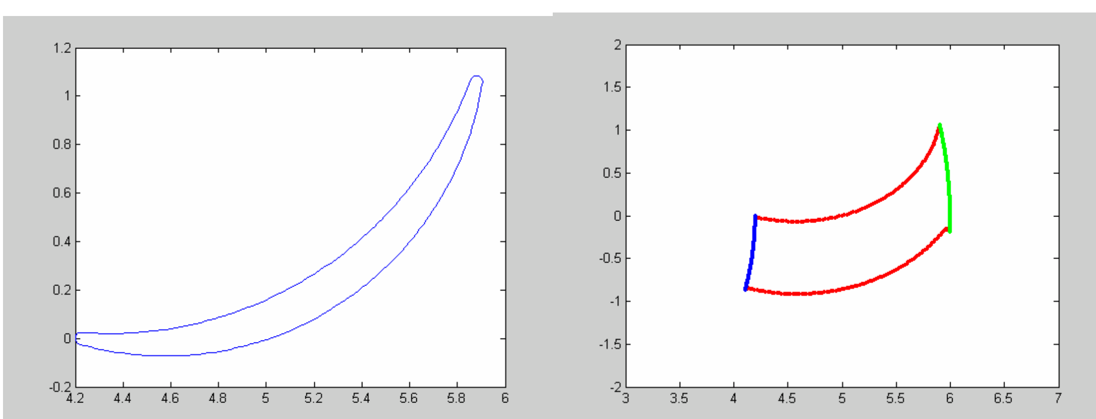

Figure 35. Matlab Generated Blade and Blade Passage Vertices

Figures 36 and 37 show the 2-D computational grid and boundary groups for the CFF respectively. The boundaries used included inlet (purple), outlet(yellow), walls

(white), and attached (orange and blue). The boundaries of type attached were used for sliding meshes where two group of grids slid against each other. The inlet and outlet boundary conditions were set to (0.97 bar and 300K) and (1bar and 300K) respectively. The reason for creating a pressure gradient was to bring the flow into the fan on the onset of the solution and thus assisting the solver computation in the initial stage. A total of 58,600 vertices and 27,130 cells were used.

The time step was set at 'Adjustable' such that the program would automatically adjust the time step in order to meet the criteria of the specified Courant number courant i.e. 1.0 in our case. If the newly calculated time step was bigger than the Courant criteria, a time step adjustment was made to specified Courant number. When stable, the previous time step was increased with the ratio of 1.5. This method ensured that the solution was always running at an optimal time step i.e. smaller time step used at the start up and bigger time step used when the solution was more stable. As the time step was varying, predicting the time for the solution to turn one revolution could only be done by observing the real run time. It also depended on the speed of the computer running the simulation. By running on a Pentium4 2.4 GHz, the estimated time taken, based on the configuration as described above, to run one revolution was 2 days.

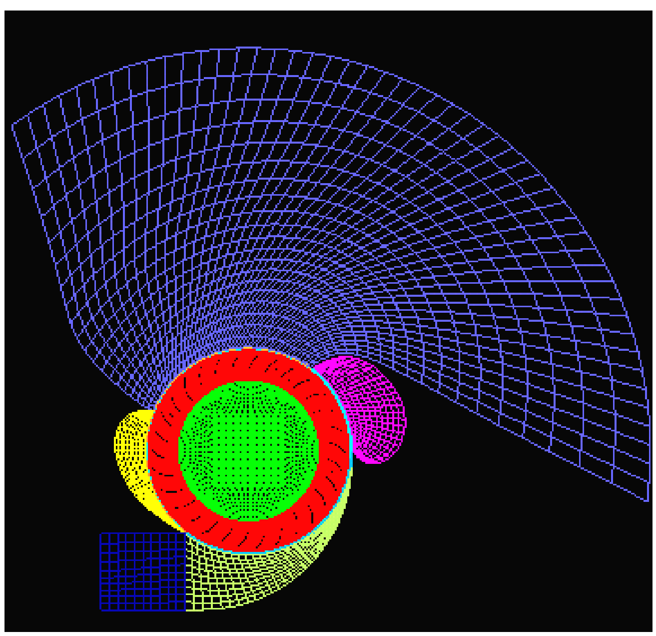

Figure 36. Complete CFF Baseline Assembly Computational Grid

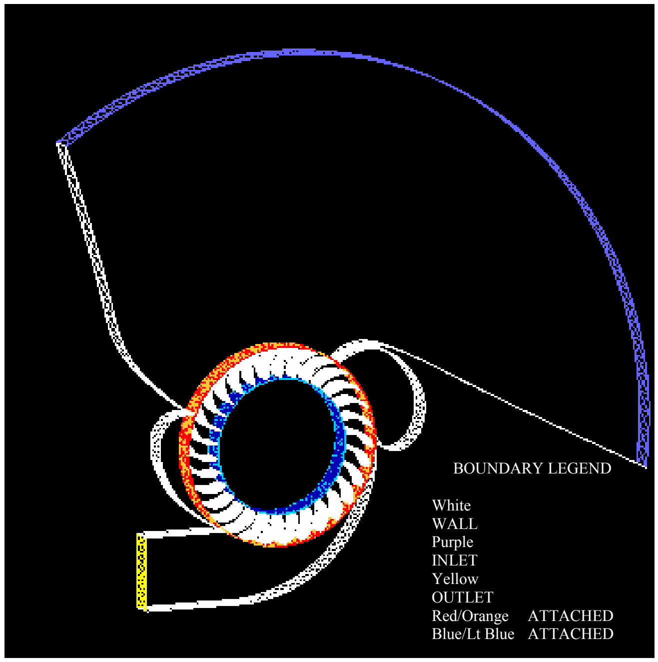

Figure 37. Boundary Groups

B. RESULTS AND DISCUSSION

1. Baseline Configuration

The main objective of studying the baseline configuration was to compare the computational results with the experiment. Figure 38 shows the contour plot of the total pressure for the model. The figure illustrates the solution after eight revolutions which were assumed to be stable based on the convergent behavior of the total-to-total pressure ratio versus no. of revolutions plots as shown in Figure 39. This showed that the solution only converged from the fourth revolution onwards and any information before that was not useful. Eight revolutions corresponded to 138,900 iterations at an average time step of approximately 1.1×10^{-6} sec. The re-circulation of flow vortices in both cavities were observed to be similar to those obtained from experiment. The lowest pressure occurred at locations just outside the left cavity, which justifies its name as the Low Pressure Cavity. The predicted total pressure ratio for this case was 1.033 versus the measured value of 1.061. Figure 40 shows the behavior of the mass flow rate with no. of revolutions. The trend of the curve follows that of Figure 39 closely. The predicted mass flow rate was 1.0 lbm/sec versus the measured value of 1.08 lbm/sec. Grid resolution and turbulence model and the difficulty of computing the flow details between rotor and housing are likely reasons for the lack of agreement with experiment.

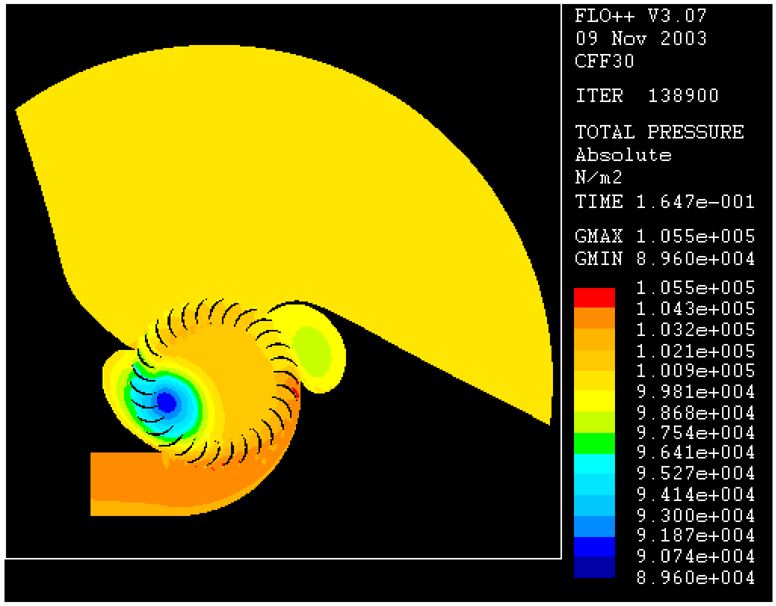

Figure 38. Contour Plot of Total Pressure at Eighth Revolution

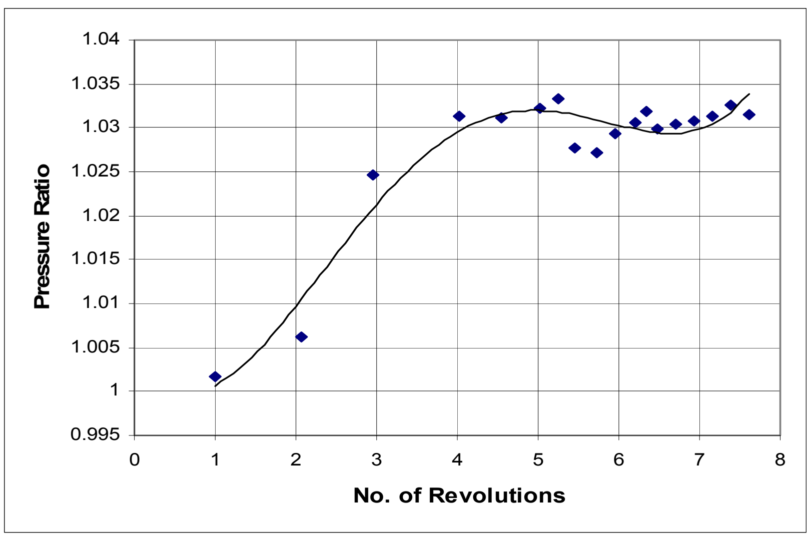

Figure 39. Total Pressure Variation with Number of Revolutions during the Computational Simulation

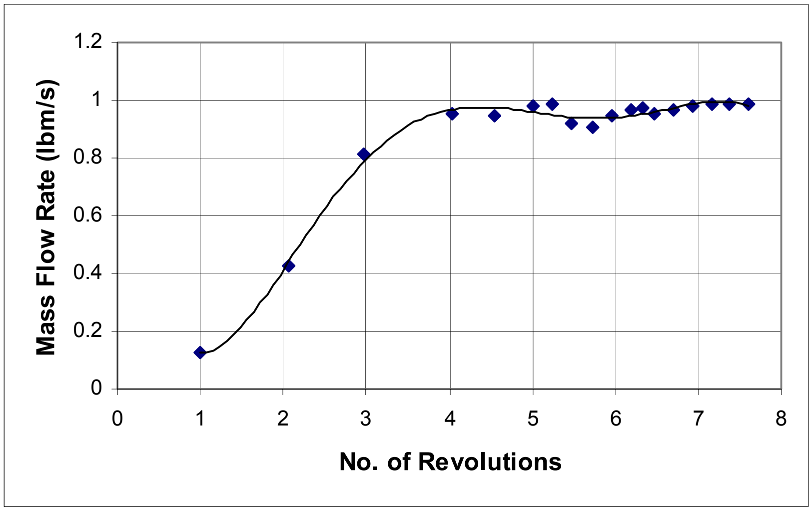

Figure 40. Mass Flow Rate with Number of Revolutions during the Computational Simulation

Figure 41 shows a contour plot of velocity magnitude for the eighth revolution solution, which also showed the two re-circulating flow vortices. The velocity was observed to be higher in the LP cavity compared to that with the HP cavity. The predicted exit velocity was about 84 m/s which was supported by an experimental value of 94 m/s.

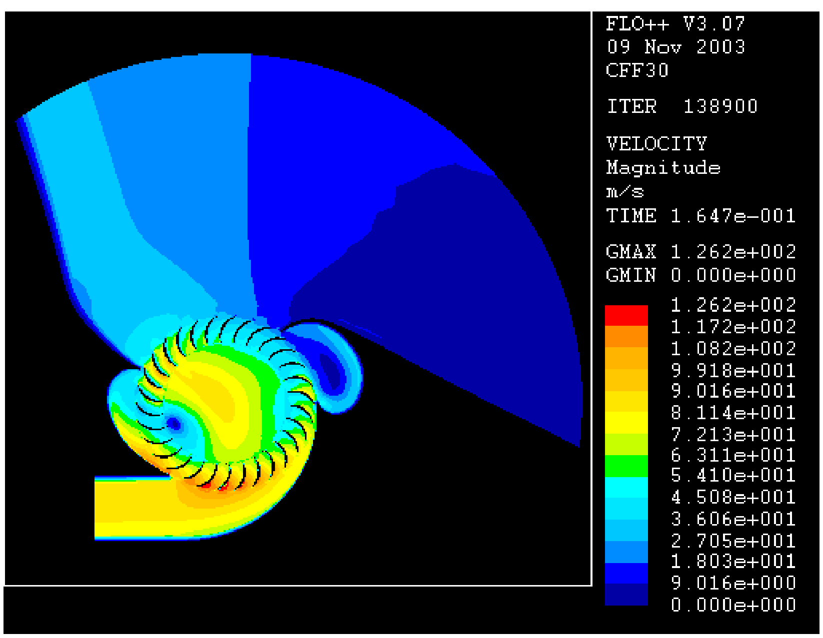

Figure 41. Contour Plot of Velocity

The vortical flow features of the two cavities are displayed in more detail in Figures 42 and 43, which are very similar to those observed during the flow visualization experiments.

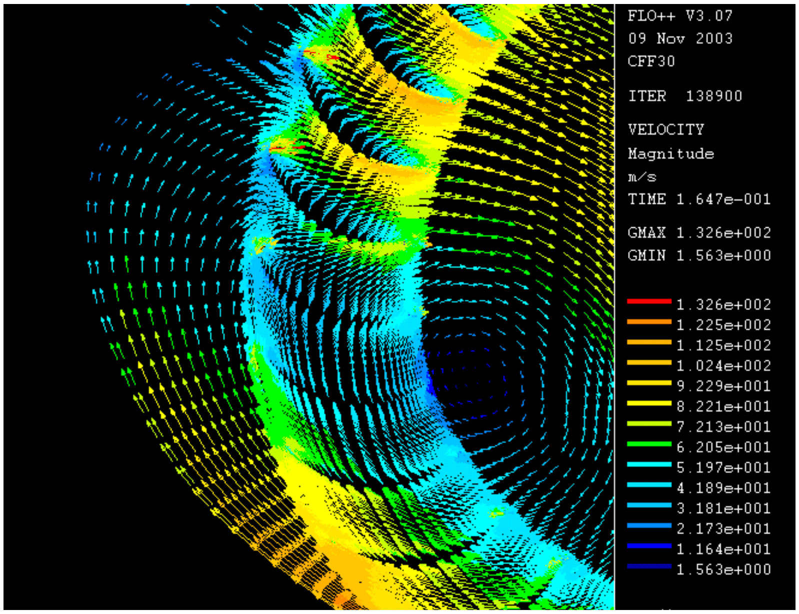

Figure 42. Vector Plot of Velocity in the LP Cavity

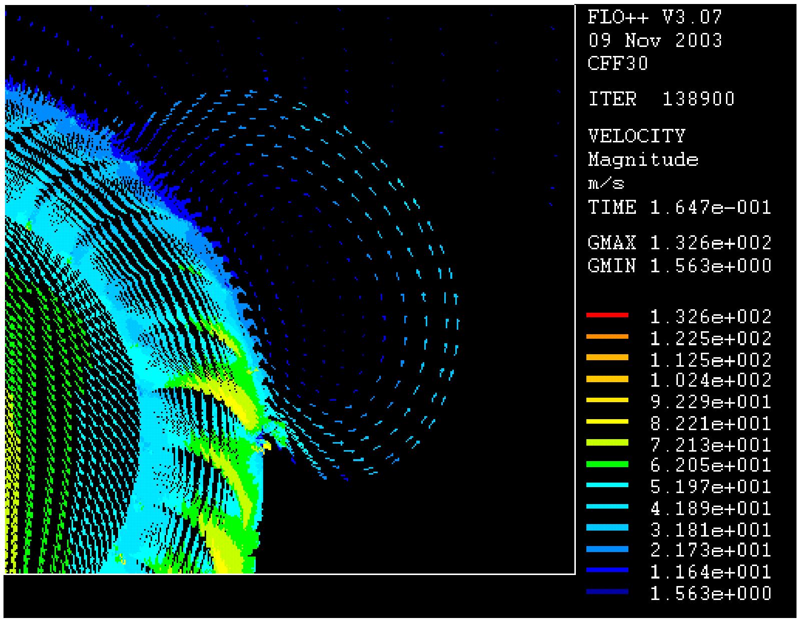

Figure 43. Vector Plot of Velocity in the HP Cavity

2. Throttling Configuration

The main objective of studying the CFF configurations with varying exhaust outlet area was to attempt to derive the compressor characteristics for 3,000 RPM. In other words, the stalling characteristics of the CFF was obtained at a speed that was found to be most efficient. It was also to understand the off-design characteristics of the CFF that were more difficult to predict and normally measured experimentally. The preprocessing files were modified from the baseline configuration to include varying exhaust outlet area.

The baseline configuration, with the original exhaust, was defined as the E100% configuration and subsequent reductions of exhaust area were defined as E**% i.e. E90% meant a CFF with 90% exhaust area. A total of 6 CFF configurations, ranging from E50% to E100% were computed.

The results for the 6 configurations of different exhaust area were computed for the 4th, 4.5th and 5th revolution. The total-to-total pressure ratio versus mass flow rate was plotted as shown in Figure 44. The pressure ratio was observed to rise to a peak value of about 1.037 at between E70% and E80% with a mass flow rate of 0.62 lbm/s and 0.7 lbm/s respectively before it fell at stall. The slight difference in the shape of the three curves was due to the fact that the solution was still fluctuating and had not reached a steady state yet as shown in Figure 39 and 40.

Next let us take a look at the pressure flow field for E100% E80% (peak efficiency) and E60% (stall) configuration at 4.5 revolutions as shown in Figure 45, 46 and 47 respectively. We observed that the vortex built up (grew bigger) on the low pressure (LP) side as the exhaust area was reduced. This was due to the back pressure from the smaller exhaust outlet and also an indication of stall.

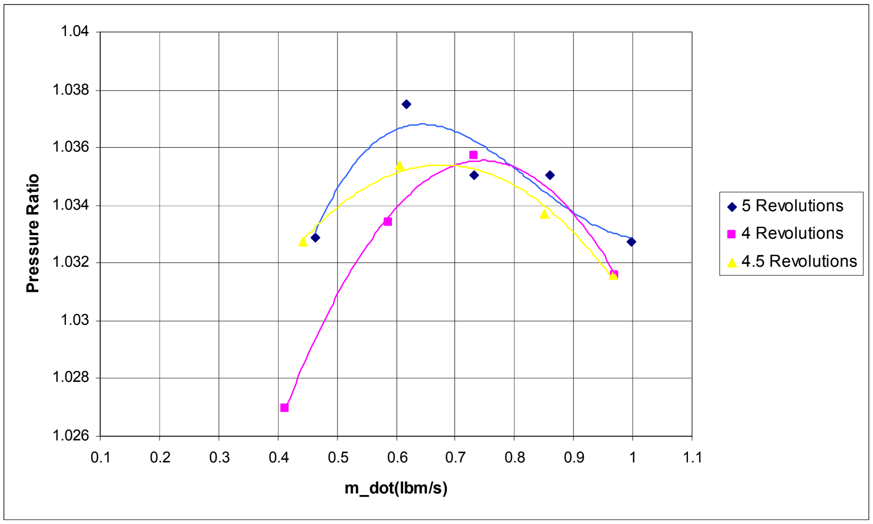

Figure 44. Pressure Plot for CFF at 3,000 RPM

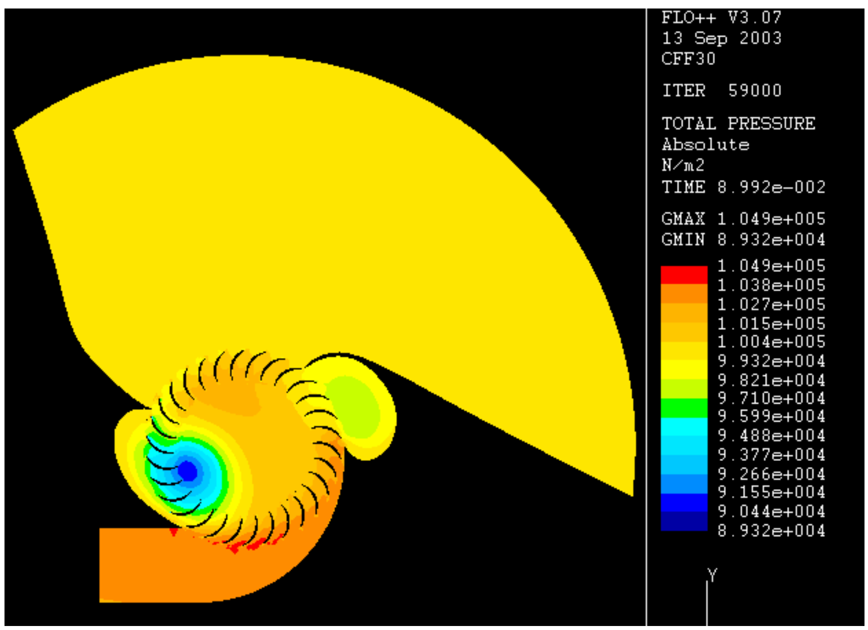

Figure 45. Contour Plot of Total Pressure for Baseline Configuration at 4.5 Revolution

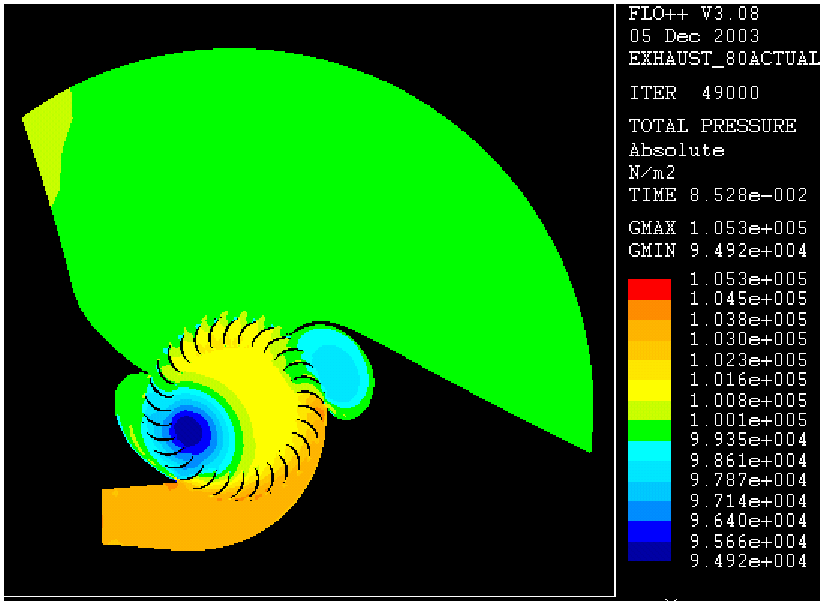

Figure 46. Contour Plot of Total Pressure for E80% (Peak Efficiency) at 4.5 Revolution

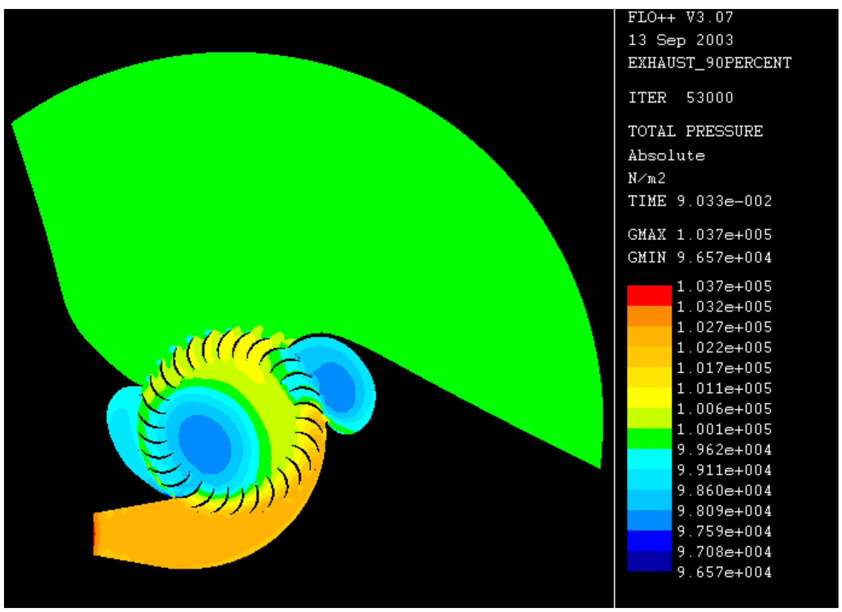

Figure 47. Contour Plot of Total Pressure for E60% Configuration at 4.5 Revolution

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IV. CONCLUSION

The Crossflow Fan Test Assembly (CFTA), which was constructed to validate the experimental tests conducted by Vought Systems Division and Seaton [Ref 5.], was used as the baseline configuration in this thesis. Improvements such as including a bellmouth to the air intake were made to the CFTA in order to achieve more accurate mass flow rate readings.

Two main test programs were conducted. The first set of tests investigated the performance of four configurations which included the baseline configuration and three others with permutations of the LP and HP Cavities opened and blanked off. The tests were conducted from 1,000 RPM to 5,000 RPM. The measured maximum efficiencies for the four configurations ranged from 66% to 74%, with the highest occurring from the LP closed & HP opened configuration. The other performance plots also showed similar trends and relatively small variance between the four configurations. It also indicated that efficiency in excess of 70% could be achieved at speeds lower than 5,000 RPM. The second set of tests investigated the stalling characteristics of two CFF configurations by means of a throttle system installed downstream of the CFTA. The two configurations were the baseline configuration and one with both cavities blanked off, with a throttling device attached to the exhaust. The tests were conducted from 2,000 RPM to 6,000 RPM. A complete compressor map was obtained by throttling the exhaust to vary the mass flow rate, t-t pressure ratio and other performance parameters. The measured maximum efficiencies for the two configurations were all in the vicinity of 75% except those running at 2,000 RPM. The stalling points for both configurations were observed to be at the same throttle setting. The efficiencies at various speeds were observed to drop drastically to about 30% after stall. But for the two cavities blanked off configuration, the efficiencies for the various speeds only dropped to 50% after stall at the same throttle setting.

Flow Visualization was conducted during all tests and the flow patterns were shown to be similar to those form VSD tests. All these results are encouraging because at these relatively low rotational speeds the use of CFFs for aircraft propulsion purposes is

likely to be advantageous from a performance and noise point of view. These data as well as the associated flow visualization and probe measurements will also make a valued data set for numerical predictions.

A 30 blade Crossflow Fan, similar to that used in the experiment, was modeled using a numerical simulation program Flo++. An incompressible, unsteady flow solution was obtained at a speed of 3,000 RPM. Based on the resolution of the grid and Courant number used, it took about 10 days to run 4 revolutions (relatively stable state). The results obtained validated that it is possible to reproduce the measured flow patterns from experiments. The throttling of the exhaust was simulated by reducing the area of the exhaust outlet. The results showed similar characteristics to a typical stalling compressor but more work is required in order to achieve a more accurate compressor map.

Future test will include variations in the blade as well as cavity configurations. Also, most importantly tests of lower diameter CFFs will be performed in view of their easier installation in aircraft wing sections.

V. RECOMMNEDATIONS

The current CFF configuration, which made up of a 12-inch diameter, 1.5-inch span and 30 blade rotor, was based on VSD's studies some 18 years back. Now that we have validated the performance of VSD's CFF, we can now take one step further by modifying the existing CFF in search for a better configuration. Since the rotor and both cavities are modular to the main assembly, modifications will be much easier and will not cost as much.

In line with the potential of installing CFF inside an aircraft's wing section as a lift / propulsion device, the diameter of the rotor should be reduced to suit the space limitation. The optimum number of blades, together with the blade profile, should also be looked into. As there are too many configurations, it is not feasible to build all the rotors to be tested. Instead, CFD can be utilized in this case to run the simulation on different configurations and finding the efficiency and power generated by the force. After which, we just need to build a few of the better configurations for testing and validation purposes. Similarly for both the cavities, we should explore different cavities design which includes the slope on top of that module that brings air into the CFF. But we understand that the current runs on the CFD software takes up a lot of time as well as effort in order to run one configuration. The difficulty in the coding makes the whole process slower. Several efforts had been put in to define a compressible flow but the solution always got unstable. Hence we can conclude that Flo++ might not be suitable for computing compressible for our CFF model. Instead, a more user friendly and established CFD softwares such as ACE and OVERFLOW should be explored to solve the compressible CFF model. Comparisons can then be made between different software and the experimental results. After which, the software which is easier to use and have shorter solution run time to steady state should be used for running the different configurations CFF as mentioned above.

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APPENDIX A. DATA LISTING

A1. TEST 1

Both Cavities Blanked	Run #	RPM	Patm	Pcal	Pin TTR (5 o/c)	Pout TTR	Pin TTR (8 o/c)	Pin CFF (2 o/c)	Pin CFF (10 o/c)	Pout CFF (Top)	Pout CFF (Mid)	Pout CFF (Bot)	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ
	1	1306.7398	29.99	39.99	29.7903	30.0700	30.5992	29.9881	29.9837	30.1864	30.2147	30.2263	29.9970	29.9962	29.9934	29.9953	29.9940	29.9857	29.9854	29.9851	29.9967	30.0014
	2	2078.1238	29.99	39.99	29.8038	30.1310	31.1224	29.9875	29.9803	30.5410	30.5909	30.5944	30.0093	30.0094	29.9971	30.0044	30.0053	29.9857	29.9834	29.9832	29.9978	30.0210
	3	2084.2019	29.99	39.99	29.8264	30.1311	31.1224	29.9868	29.9786	30.5410	30.5817	30.5866	30.0096	30.0088	29.9932	30.0015	30.0039	29.9840	29.9819	29.9808	29.9939	30.0185
	4	3000.0601	29.99	39.99	29.8497	30.2682	32.1052	29.9847	29.9704	31.2439	31.3407	31.2754	30.0270	30.0272	29.9842	29.9938	30.0243	29.9820	29.9779	29.9771	29.9906	30.0455
	5	3009.2387	29.99	39.99	29.8648	30.2688	32.0949	29.9828	29.9670	31.2421	31.3384	31.2863	30.0265	30.0257	29.9829	29.9895	30.0247	29.9809	29.9757	29.9743	29.9857	30.0463
	6	4015.9303	29.99	39.99	29.9130	30.5175	33.6266	29.9844	29.9648	32.3384	32.4877	32.3436	30.0568	30.0507	29.9884	29.9881	30.0609	29.9922	29.9790	29.9780	29.9868	30.0976
	7	4012.1708	29.99	39.99	29.9220	30.5200	33.6236	29.9828	29.9599	32.3487	32.5017	32.3560	30.0499	30.0425	29.9975	29.9837	30.0586	29.9820	29.9779	29.9771	29.9871	30.0949
	8	4999.4176	29.99	39.99	29.9695	30.8167	35.6525	29.9828	29.9492	33.8183	34.1149	33.6358	30.0735	29.9968	30.0441	30.0067	30.0221	29.9718	29.9772	29.9761	29.9901	30.1338
	9	5007.0939	29.85	39.85	29.8450	30.6693	35.4829	29.8418	29.8020	33.6473	33.9599	33.4690	29.9192	29.8712	29.8989	29.8890	29.8928	29.8324	29.8360	29.8347	29.8502	29.9862
	11	4497.5156	29.90	39.90	29.9059	30.5599	34.4321	29.8918	29.8602	32.9107	33.1519	32.8509	29.9493	29.9266	29.8810	29.9180	29.9535	29.8812	29.8865	29.8852	29.8868	30.0261
	12	4501.8350	29.90	39.90	29.9159	30.5618	34.4302	29.8920	29.8609	32.9132	33.1271	32.8472	29.9455	29.9247	29.8803	29.9213	29.9512	29.8794	29.8862	29.8852	29.8897	30.0220
	13	3493.6741	29.90	39.90	29.9212	30.3025	32.6516	29.8941	29.8808	31.6499	31.7943	31.6700	29.9296	29.9146	29.8852	29.9015	29.9321	29.8820	29.8858	29.8843	29.8833	29.9792
	14	3503.5682	29.90	39.90	29.9253	30.3060	32.6499	29.8933	29.8731	31.6438	31.7914	31.6784	29.9325	29.9165	29.8857	29.9040	29.9344	29.8827	29.8861	29.8859	29.8846	29.9823
	15	2502.2000	29.90	39.90	29.9081	30.1102	31.3661	29.8932	29.8861	30.7339	30.8066	30.7927	29.9120	29.9062	29.8857	29.8907	29.9122	29.8827	29.8851	29.8838	29.8801	29.9353
	16	2491.4566	29.90	39.90	29.9098	30.1080	31.3563	29.8932	29.8845	30.7284	30.8113	30.7780	29.9125	29.9042	29.8860	29.8925	29.9149	29.8833	29.8856	29.8847	29.8832	29.9356
	17	1511.4150	29.90	39.90	29.8890	29.9908	30.5695	29.8966	29.8902	30.1757	30.2075	30.2179	29.9017	29.9018	29.8921	29.8941	29.9032	29.8869	29.8870	29.8867	29.8817	29.9079
	18	1512.9624	29.90	39.90	29.8863	29.9885	30.5649	29.8955	29.8913	30.1746	30.2035	30.2106	29.9015	29.9018	29.8908	29.8925	29.9022	29.8882	29.8888	29.8878	29.8834	29.9090

Both Cavities Opened`	Run #	RPM	Patm	Pcal	Pin TTR (5 o/c)	Pout TTR	Pin TTR (8 o/c)	Pin CFF (2 o/c)	Pin CFF (10 o/c)	Pout CFF (Top)	Pout CFF (Mid)	Pout CFF (Bot)	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ
	1	1006.9852	29.95	39.95	29.5640	30.0265	30.4445	29.9512	29.9229	30.1022	30.1117	30.1238	29.9586	29.8238	29.8694	29.9195	29.9494	29.9390	29.9077	29.9015	29.9311	29.9806
	2	1006.9564	29.95	39.95	29.5688	30.0258	30.4486	29.9499	29.9222	30.1028	30.1110	30.1233	29.9571	29.8229	29.8678	29.9184	29.9475	29.9381	29.9068	29.9007	29.9280	29.9797
	3	2016.5018	29.95	39.95	29.6127	30.1609	31.3540	29.9492	29.8335	30.6238	30.6276	30.6439	29.9813	29.3501	29.5602	29.8316	29.9921	29.8986	29.7378	29.7099	29.8052	30.0519
	4	2011.4520	29.95	39.95	29.6357	30.1634	31.3632	29.9485	29.8303	30.6279	30.6329	30.6547	29.9798	29.3411	29.5563	29.8311	29.9902	29.8949	29.7357	29.7065	29.8027	30.0499
	5	2994.6099	29.95	39.95	29.6864	30.3963	32.8962	29.9479	29.6806	31.5558	31.5788	31.5222	30.0226	28.5373	29.0193	29.6450	30.0119	29.8324	29.4450	29.3848	29.4992	30.1505
	6	2999.6852	29.95	39.95	29.7378	30.4347	32.8918	29.9460	29.6796	31.5514	31.5745	31.5086	30.0211	28.5436	29.0187	29.6451	30.0113	29.8318	29.4421	29.3841	29.4967	30.1504
	7	4005.0737	29.95	39.95	29.7719	30.8183	35.1107	29.9432	29.4555	32.9332	32.8585	32.7508	30.0845	27.3532	28.1699	29.2951	29.9842	29.7412	29.0184	28.9105	29.0974	30.2891
	8	4015.0973	29.95	39.95	29.7952	30.8282	35.1352	29.9428	29.4574	32.9513	32.8888	32.7426	30.0844	27.3363	28.1557	29.2896	29.9822	29.7409	29.0195	28.9084	29.0971	30.2908
	9	4995.6711	29.95	39.95	29.8375	31.2945	37.9884	29.9410	29.1695	34.6292	34.6044	34.4146	30.1734	25.8555	27.0172	28.7404	29.8387	29.6313	28.4677	28.3223	28.5595	30.4470
	10	4987.4907	29.95	39.95	29.8513	31.2972	37.9746	29.9390	29.1624	34.6321	34.6023	34.4221	30.1736	25.8379	27.0045	28.7320	29.8312	29.6325	28.4619	28.3186	28.5630	30.4400

Both Cavities Blanked	Run #	RPM	PK	PL	Pin	Pin (Flange)	Pout (Flange)	Pout (Vena)	Tin CFF (2 o/c)	Tin CFF (11 o/c)	Tin TTR (8 o/c)	Tin TTR (5 o/c)	Tout TTR	Tin Orifice	Tout CFF (Bot)	Tout CFF (Mid)	Tout CFF (Top)	TTR Mass Flow (lbm/s)	Turbine Power (HP)	CFF Mass Flow (lbm/s)	Pi CFF	Tau CFF	CFF Efficiency	CFF Corrected Mass Flow (lbm/s)
	1	1306.7398	29.9842	29.9842	33.2375	29.9839	33.2029	33.2466	531.5284	532.8679	536.6173	536.5259	534.6327	540.1927	534.5167	534.5958	534.2934	0.6112	-0.2844	0.5219	1.0074	1.0043	0.4972	0.5270
	2	2078.1238	29.9823	29.9820	33.0972	29.9810	33.0749	33.0706	533.0524	533.6307	537.1692	537.1147	533.6149	540.3772	537.7317	538.0253	537.4294	1.0290	-0.8710	0.8272	1.0197	1.0082	0.6805	0.8362
	3	2084.2019	29.9803	29.9801	33.1121	29.9796	33.0776	33.0674	532.5251	533.6659	537.3538	537.2958	533.8557	540.4335	537.4733	537.9286	537.4733	1.3280	-1.1056	1.0171	1.0196	1.0085	0.6538	1.0279
	4	3000.0601	29.9750	29.9745	35.6736	29.9736	35.6302	35.6322	532.2702	532.8661	537.9796	537.9374	531.8272	540.4018	540.8184	542.0014	541.3932	1.3269	-1.9525	0.9207	1.0437	1.0166	0.7405	0.9302
	5	3009.2387	29.9719	29.9717	35.7017	29.9697	35.6373	35.6309	532.7870	533.1544	538.1641	538.1096	531.9837	540.3755	541.8591	542.8680	541.9962	1.7283	-2.5524	1.1472	1.0438	1.0174	0.7091	1.1596
	6	4015.9303	29.9753	29.9752	38.9254	29.9734	38.8406	38.8418	532.5602	532.0927	538.9552	538.8796	528.8970	540.8641	547.9868	549.8501	548.5739	1.9562	-4.7045	1.1896	1.0806	1.0310	0.7233	1.2018
	7	4012.1708	29.9749	29.9749	38.8941	29.9732	38.8450	38.8507	532.0259	532.1138	539.0202	538.9710	528.9673	541.0962	547.8163	549.7850	548.6846	1.4160	-3.4079	0.8507	1.0811	1.0314	0.7181	0.8593
	8	4999.4176	29.9743	29.9745	41.0557	29.9715	40.9577	40.9757	532.7061	530.8657	539.6706	539.6618	524.5024	541.6305	556.2098	559.7026	557.5475	1.9654	-7.1527	1.1448	1.1298	1.0490	0.7249	1.1562
	9	5007.0939	29.8331	29.8332	40.9447	29.8306	40.8108	40.8184	533.2968	531.7868	539.7532	539.7022	524.6430	541.7044	557.0641	560.5745	558.3790	2.4579	-8.8984	1.4189	1.1298	1.0491	0.7230	1.4410
	11	4497.5156	29.8834	29.8835	38.9023	29.8816	38.8230	38.8317	533.0138	532.3616	540.1575	540.1241	527.8054	541.9505	552.8102	555.3028	553.5784	1.7980	-5.3229	1.0457	1.1036	1.0398	0.7174	1.0602
	12	4501.8350	29.8835	29.8833	38.9466	29.8801	38.8324	38.8244	533.9243	532.8415	540.2208	540.1505	527.8932	542.0436	553.5186	555.9602	554.1128	2.3580	-6.9564	1.3706	1.1033	1.0396	0.7184	1.3906
	13	3493.6741	29.8819	29.8815	37.7395	29.8802	37.6852	37.6930	533.5798	534.2618	540.1136	540.0432	532.3388	541.9329	545.8897	547.4348	546.4927	1.4410	-2.6767	0.8792	1.0608	1.0238	0.7158	0.8921
	14	3503.5682	29.8833	29.8818	37.7666	29.8802	37.7203	37.7157	533.4778	533.3249	540.0872	540.0380	532.3827	541.9399	545.4327	546.9954	546.0444	1.5084	-2.7802	0.9081	1.0609	1.0239	0.7128	0.9212
	15	2502.2000	29.8808	29.8807	34.6437	29.8785	34.5922	34.6029	533.8786	534.8471	539.8903	539.8393	535.5661	541.9311	540.6708	541.5180	541.0839	1.2954	-1.3365	0.8277	1.0297	1.0126	0.6672	0.8401
	16	2491.4566	29.8822	29.8813	34.6359	29.8796	34.5920	34.6055	533.7977	535.3692	539.8956	539.8341	535.6048	541.9452	541.0610	541.9241	541.4126	1.1213	-1.1464	0.6941	1.0296	1.0129	0.6493	0.7047
	17	1511.4150	29.8851	29.8844	33.1544	29.8828	33.1227	33.1295	532.5585	534.8805	539.5968	539.5141	537.5348	541.8960	535.9018	536.5891	536.7491	0.9957	-0.4829	0.7469	1.0103	1.0050	0.5791	0.7575
	18	1512.9624	29.8853	29.8849	33.1396	29.8836	33.1159	33.1399	532.6692	534.5571	539.5229	539.4807	537.5471	541.8942	536.6788	537.1200	536.8845	0.1279	-0.0600	0.0762	1.0101	1.0061	0.4690	0.0773
Both Cavities opened	Run #	RPM	PK	PL	Pin	Pin (Flange)	Pout (Flange)	Pout (Vena)	Tin CFF (2 o/c)	Tin CFF (11 o/c)	Tin TTR (8 o/c)	Tin TTR (5 o/c)	Tout TTR	Tin Orifice	Tout CFF (Bot)	Tout CFF (Mid)	Tout CFF (Top)	TTR Mass Flow (lbm/s)	Turbine Power (HP)	CFF Mass Flow (lbm/s)	Pi CFF	Tau CFF	CFF Efficiency	Mass Flow (lbm/s)
	1	1006.9852	29.9515	29.9514	33.3828	29.9517	33.3427	33.3555	523.4214	531.1804	537.6421	537.5296	535.9809	541.1225	530.2259	531.8835	532.0417	1.0471	-0.4033	0.4116	1.0059	1.0077	0.2159	0.4144
	2	1006.9564	29.9509	29.9509	33.3576	29.9514	33.3481	33.3611	523.8257	530.5950	537.6139	537.5348	536.0179	540.8747	531.1786	532.2315	531.7903	0.3883	-0.1451	0.1336	1.0059	1.0086	0.1957	0.1345
	3	2016.5018	29.9485	29.9483	39.3086	29.9486	39.2638	39.2709	526.6311	531.2278	537.8126	537.7581	533.9348	539.7954	534.4024	535.9809	535.9071	1.3293	-1.2285	0.7874	1.0248	1.0123	0.5708	0.7951
	4	2011.4520	29.9473	29.9474	39.3205	29.9472	39.2906	39.2767	527.2235	530.4596	537.8917	537.8389	534.0263	540.6954	534.4780	535.8491	535.8175	1.4304	-1.3179	0.8397	1.0251	1.0124	0.5739	0.8479
	5	2994.6099	29.9453	29.9451	38.9464	29.9450	38.8753	38.8661	528.7388	531.7973	538.4102	538.3979	530.7602	541.5268	541.6921	544.2638	544.0616	1.9175	-3.5177	1.1213	1.0583	1.0246	0.6620	1.1367
	6	2999.6852	29.9427	29.9425	38.9042	29.9421	38.8895	38.8584	530.5423	530.7479	538.4243	538.3874	530.7444	540.6110	541.2350	543.3268	543.4552	1.4532	-2.6721	0.9257	1.0581	1.0227	0.7176	0.9388
	7	4005.0737	29.9386	29.9385	39.8618	29.9373	39.7389	39.7426	530.6249	530.9764	538.7653	538.7477	525.8805	541.1489	551.6290	554.2622	554.0548	2.3591	-7.2902	1.3492	1.1060	1.0424	0.6885	1.3736
	8	4015.0973	29.9392	29.9392	39.8781	29.9380	39.7523	39.7864	529.2520	530.1239	539.1063	539.0975	526.1337	542.0120	550.9944	553.9001	553.7964	2.0708	-6.4451	1.1571	1.1064	1.0438	0.6690	1.1768
	9	4995.6711	29.9388	29.9382	42.0636	29.9362	41.9068	41.8989	530.7638	529.2345	538.9147	538.9112	519.8249	540.3491	563.2692	566.5546	565.9921	2.8446	-13.0315	1.5394	1.1690	1.0666	0.6854	1.5737
	10	4987.4907	29.9377	29.9379	42.1118	29.9371	41.9162	41.9542	528.5542	528.3714	539.3419	539.3138	520.1571	541.4249	561.4147	565.6405	565.4893	2.7826	-12.8025	1.4934	1.1692	1.0676	0.6759	1.5248

Both Cavities Blanked	Run #	RPM	Corrected Power (HP)	Corrected Speed (RPM)	X1	mdot1	X2	mdot2	X3	mdot3	Computed MA Mdot	Computed MA HP	Corrected Computed MA Mdot(lbm/s)	Corrected Computed MA HP	Pt_bar	Tt_bar	Mach Exit	Temp Exit	Velocity Exit	Corrected Thrust
	1	1306.7398	0.3964	1291.3049	0.0424	0.1465	0.0454	0.0897	0.0466	0.1612	0.3974	0.3041	0.4017	0.2996	30.2090	534.4522	0.1173	531.5289	40.4171	13.2534
	2	2078.1238	1.2128	2051.3749	0.0707	0.2447	0.0740	0.1462	0.0742	0.2566	0.6476	0.9546	0.6552	0.9394	30.5734	537.6837	0.1760	531.1068	60.6230	32.4267
	3	2084.2019	1.5399	2057.8497	0.0707	0.2446	0.0734	0.1450	0.0737	0.2549	0.6446	0.9804	0.6521	0.9650	30.5682	537.5757	0.1752	531.0521	60.3770	32.1372
	4	3000.0601	2.7213	2963.5941	0.1062	0.3687	0.1103	0.2188	0.1076	0.3736	0.9611	2.8517	0.9720	2.8089	31.2782	541.3082	0.2526	527.8330	86.7746	68.8369
	5	3009.2387	3.5563	2971.5384	0.1062	0.3683	0.1102	0.2184	0.1080	0.3750	0.9617	2.9940	0.9731	2.9482	31.2812	542.1407	0.2529	528.6159	86.9343	69.0341
	6	4015.9303	6.5589	3968.0168	0.1438	0.5012	0.1482	0.2952	0.1440	0.5020	1.2984	7.1894	1.3129	7.0839	32.3743	548.6371	0.3375	524.7293	115.5833	123.8380
	7	4012.1708	4.7529	3965.2581	0.1444	0.5029	0.1489	0.2964	0.1446	0.5041	1.3035	7.3147	1.3179	7.2098	32.3863	548.5991	0.3383	524.5844	115.8414	124.5768
	8	4999.4176	9.9801	4942.2801	0.1816	0.6359	0.1881	0.3766	0.1774	0.6211	1.6337	14.2816	1.6516	14.0831	33.8173	557.5358	0.4219	520.4745	143.9083	193.9116
	9	5007.0939	12.4670	4946.3546	0.1816	0.6324	0.1885	0.3753	0.1776	0.6180	1.6257	14.2640	1.6527	14.1237	33.6517	558.3861	0.4132	522.6849	141.2429	189.5250
	11	4497.5156	7.4431	4442.3494	0.1630	0.5669	0.1691	0.3363	0.1615	0.5616	1.4647	10.4384	1.4865	10.3157	32.9431	553.6798	0.3734	524.4337	127.8376	154.5694
	12	4501.8350	9.7208	4443.7170	0.1632	0.5672	0.1686	0.3349	0.1615	0.5612	1.4633	10.3950	1.4860	10.2658	32.9368	554.3078	0.3730	525.0847	127.7876	154.4601
	13	3493.6741	3.7371	3446.8337	0.1259	0.4354	0.1308	0.2587	0.1266	0.4381	1.1322	4.8255	1.1500	4.7614	31.6907	546.4747	0.2878	528.9524	98.9511	92.5915
	14	3503.5682	3.8841	3458.2779	0.1255	0.4344	0.1306	0.2585	0.1267	0.4390	1.1319	4.8506	1.1492	4.7892	31.6909	546.0243	0.2878	528.5146	98.9157	92.4853
	15	2502.2000	1.8650	2467.6312	0.0878	0.3027	0.0916	0.1803	0.0909	0.3134	0.7964	1.7998	0.8092	1.7750	30.7735	541.0196	0.2009	532.4276	69.2904	45.6252
	16	2491.4566	1.5995	2456.5292	0.0875	0.3015	0.0918	0.1807	0.0901	0.3106	0.7928	1.8323	0.8057	1.8067	30.7667	541.3914	0.2001	532.8601	69.0454	45.2652
	17	1511.4150	0.6741	1491.4323	0.0510	0.1755	0.0539	0.1060	0.0548	0.1887	0.4702	0.4236	0.4774	0.4180	30.1998	536.3730	0.1154	533.5314	39.8480	15.4834
	18	1512.9624	0.0838	1493.1080	0.0509	0.1752	0.0535	0.1053	0.0542	0.1865	0.4670	0.5140	0.4740	0.5072	30.1955	536.8554	0.1145	534.0544	39.5628	15.2633

Both Cavities opened	Run #	RPM	Corrected Power (HP)	Corrected Speed (RPM)	X1	mdot1	X2	mdot2	X3	mdot3	Computed MA Mdot	Computed MA HP	Corrected Computed MA Mdot(lbm/s)	Corrected Computed MA HP	Pt_bar	Tt_bar	Mach Exit	Temp Exit	Velocity Exit	Corrected Thrust
	1	1006.9852	0.5657	999.7011	0.0369	0.1277	0.0381	0.0754	0.0396	0.1373	0.3404	0.4592	0.3431	0.4552	30.1130	531.2744	0.0959	529.3275	32.9833	9.2223
	2	1006.9564	0.2035	999.7584	0.0372	0.1287	0.0382	0.0756	0.0397	0.1376	0.3419	0.5143	0.3445	0.5098	30.1128	531.6417	0.0958	529.6954	32.9785	9.2585
	3	2016.5018	1.7230	1998.8311	0.0777	0.2693	0.0779	0.1543	0.0789	0.2738	0.6974	1.5160	0.7049	1.5027	30.6326	535.3326	0.1837	528.2048	63.1111	36.2044
	4	2011.4520	1.8487	1993.9912	0.0781	0.2705	0.0783	0.1551	0.0796	0.2763	0.7019	1.5383	0.7095	1.5250	30.6396	535.2971	0.1846	528.1010	63.4125	36.6096
	5	2994.6099	4.9403	2964.6190	0.1189	0.4127	0.1197	0.2375	0.1176	0.4090	1.0592	4.6472	1.0747	4.6126	31.5480	543.1919	0.2762	527.1117	94.7919	82.6930
	6	2999.6852	3.7515	2968.5882	0.1188	0.4125	0.1196	0.2375	0.1171	0.4075	1.0575	4.2816	1.0735	4.2483	31.5401	542.5708	0.2755	526.5831	94.5189	82.3548
	7	4005.0737	10.2728	3962.9732	0.1597	0.5571	0.1577	0.3141	0.1548	0.5403	1.4115	10.7202	1.4385	10.6760	32.8468	553.1724	0.3676	524.8084	125.8952	146.4284
	8	4015.0973	9.0913	3977.0622	0.1602	0.5590	0.1586	0.3159	0.1546	0.5398	1.4147	11.0761	1.4401	11.0418	32.8577	552.7505	0.3682	524.3109	126.0627	146.7995
	9	4995.6711	18.4665	4946.8943	0.1964	0.6891	0.1959	0.3925	0.1920	0.6741	1.7556	20.9039	1.7965	20.9351	34.5412	565.0724	0.4577	521.3904	156.2343	225.8466
	10	4987.4907	18.1712	4945.9675	0.1965	0.6896	0.1959	0.3927	0.1922	0.6757	1.7580	21.1840	1.7967	21.2496	34.5447	563.9569	0.4578	520.3325	156.1313	225.6815

LP Cav opened HP Cav closed	Run #	RPM	Patm	Pcal	Pin TTR (5 o/c)	Pout TTR	Pin TTR (8 o/c)	Pin CFF (2 o/c)	Pin CFF (10 o/c)	Pout CFF (Top)	Pout CFF (Mid)	Pout CFF (Bot)	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ
	1	1042.3852	29.96	39.96	29.6042	30.0379	30.5268	29.9593	29.9336	30.1165	30.1201	30.1330	29.9599	29.9638	29.9584	29.9567	29.9628	29.9596	29.9605	29.9599	29.9659	29.9820
	2	1063.8977	29.96	39.96	29.6360	30.0383	30.5336	29.9592	29.9289	30.1336	30.1363	30.1503	29.9597	29.9642	29.9590	29.9572	29.9637	29.9587	29.9594	29.9594	29.9642	29.9836
	3	1492.4446	29.96	39.96	29.7061	30.0823	30.8424	29.9598	29.9017	30.3158	30.3152	30.3280	29.9616	29.9689	29.9579	29.9533	29.9705	29.9575	29.9591	29.9586	29.9608	30.0000
	4	1502.9345	29.96	39.96	29.7201	30.0809	30.8369	29.9586	29.9005	30.3149	30.3143	30.3239	29.9605	29.9679	29.9572	29.9529	29.9691	29.9576	29.9591	29.9588	29.9613	30.0005
	5	2008.6776	29.96	39.96	29.7396	30.1530	31.3325	29.9578	29.8525	30.6317	30.6279	30.6148	29.9671	29.9755	29.9550	29.9537	29.9769	29.9538	29.9557	29.9557	29.9579	30.0245
	6	2016.3596	29.96	39.96	29.7472	30.1524	31.3380	29.9557	29.8491	30.6279	30.6222	30.6061	29.9657	29.9744	29.9527	29.9512	29.9767	29.9517	29.9538	29.9536	29.9522	30.0228
	7	2499.2816	29.96	39.96	29.7633	30.2413	31.9767	29.9555	29.7825	31.1040	31.0299	30.9625	29.9762	29.9826	29.9507	29.9551	29.9870	29.9498	29.9521	29.9518	29.9545	30.0521
	8	2509.5469	29.96	39.96	29.7823	30.2404	31.9774	29.9557	29.7866	31.0967	31.0259	30.9522	29.9769	29.9808	29.9482	29.9546	29.9869	29.9492	29.9518	29.9513	29.9524	30.0532
	9	3003.2288	29.96	39.96	29.8017	30.3631	32.7586	29.9539	29.7140	31.5336	31.5028	31.4130	29.9873	29.9921	29.9378	29.9528	29.9951	29.9445	29.9485	29.9475	29.9474	30.0839
	10	2994.8191	29.96	39.96	29.8150	30.3653	32.7663	29.9531	29.7092	31.5423	31.4940	31.4101	29.9854	29.9956	29.9369	29.9539	29.9909	29.9433	29.9480	29.9473	29.9473	30.0826
	11	3502.6274	29.96	39.96	29.8667	30.5565	33.7166	29.9544	29.6144	32.1834	32.1253	31.9681	29.9998	30.0170	29.9890	29.9590	30.0070	29.9434	29.9526	29.9522	29.9491	30.1301
	12	3512.8603	29.96	39.96	29.8634	30.5599	33.7270	29.9548	29.6133	32.1863	32.1141	31.9779	29.9986	30.0156	29.9912	29.9572	30.0097	29.9425	29.9513	29.9509	29.9477	30.1317
	13	4007.9899	29.96	39.96	29.8744	30.7528	34.8455	29.9521	29.5056	32.9305	32.8012	32.5953	30.0137	30.0281	30.0190	29.9621	30.0212	29.9342	29.9505	29.9498	29.9551	30.1768
	14	4006.9728	29.96	39.96	29.8871	30.7494	34.8556	29.9514	29.5066	32.9416	32.8146	32.6246	30.0136	30.0278	30.0204	29.9626	30.0214	29.9322	29.9500	29.9493	29.9549	30.1748
	15	4514.6394	29.96	39.96	29.9017	30.9609	36.1456	29.9518	29.3860	33.7980	33.5896	33.3211	30.0272	30.0454	30.0442	29.9640	30.0379	29.9225	29.9488	29.9481	29.9516	30.2234
	16	4505.6213	29.96	39.96	29.9069	30.9624	36.1539	29.9500	29.3815	33.7969	33.5956	33.3021	30.0226	30.0444	30.0451	29.9638	30.0340	29.9241	29.9485	29.9476	29.9524	30.2252
	17	4986.2469	29.96	39.96	29.9254	31.1902	37.5628	29.9492	29.2437	34.6447	34.5483	34.1030	30.0406	30.0583	30.0661	29.9495	30.0516	29.9269	29.9473	29.9458	29.9476	30.2717
	18	5001.0844	29.96	39.96	29.9303	31.1921	37.5901	29.9508	29.2406	34.6643	34.5406	34.1329	30.0417	30.0582	30.0617	29.9449	30.0502	29.9295	29.9470	29.9456	29.9544	30.2720
	19	3005.8918	29.96	39.96	29.9503	30.4145	32.6951	29.9573	29.7103	31.5423	31.5104	31.4490	29.9888	29.9978	29.9997	29.9633	29.9948	29.9561	29.9549	29.9543	29.9505	30.0863
	20	2997.6321	29.96	39.96	29.9458	30.4089	32.6769	29.9560	29.7139	31.5352	31.5000	31.4132	29.9870	29.9959	29.9973	29.9612	29.9901	29.9546	29.9524	29.9520	29.9477	30.0860

LP_Cav closed HP_Cav opened	Run #	RPM	Patm	Pcal	Pin TTR (5 o/c)	Pout TTR	Pin TTR (8 o/c)	Pin CFF (2 o/c)	Pin CFF (10 o/c)	Pout CFF (Top)	Pout CFF (Mid)	Pout CFF (Bot)	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ
	1	1165.875	29.94	39.935	29.3996	30.0175	30.5231	29.93536	29.9089	30.0945	30.1223	30.1392	29.9413	29.9453	29.9441	29.93428	29.9443	29.9372	29.8647	29.8572	29.9182	29.965
	2	1189.754	29.94	39.935	29.4494	30.0175	30.5256	29.93455	29.9055	30.1078	30.1388	30.1584	29.9399	29.9451	29.9437	29.93318	29.9445	29.9358	29.8582	29.8494	29.9039	29.964
	3	1489.24	29.94	39.935	29.4653	30.0408	30.7127	29.93407	29.8886	30.2206	30.2584	30.2814	29.9425	29.9462	29.9446	29.92998	29.9446	29.9338	29.8106	29.7945	29.8778	29.976
	4	1507.435	29.94	39.935	29.4772	30.0418	30.7139	29.93304	29.8879	30.2174	30.25	30.2777	29.9418	29.9464	29.9446	29.93012	29.9447	29.9334	29.8066	29.7932	29.8767	29.976
	5	1994.834	29.94	39.935	29.5181	30.0842	31.0913	29.93148	29.8458	30.4664	30.5389	30.5452	29.946	29.9509	29.9494	29.9247	29.9487	29.9333	29.6961	29.6709	29.7492	30
	6	2045.889	29.94	39.935	29.5347	30.0848	31.0915	29.93159	29.8458	30.4694	30.5394	30.5534	29.9442	29.9509	29.9494	29.92548	29.951	29.9343	29.6951	29.6682	29.7409	30.001
	7	2498.418	29.94	39.935	29.5557	30.1526	31.5998	29.9316	29.793	30.8148	30.9009	30.8955	29.9517	29.9578	29.9536	29.91894	29.9559	29.9376	29.5546	29.5137	29.6061	30.03
	8	2501.647	29.94	39.935	29.5748	30.1541	31.6002	29.92985	29.7928	30.8192	30.8902	30.8977	29.952	29.9581	29.954	29.91865	29.9548	29.9366	29.5549	29.5135	29.6054	30.029
	9	3003.349	29.94	39.935	29.6022	30.2449	32.2607	29.93039	29.7283	31.2323	31.3996	31.3355	29.9561	29.9677	29.9577	29.91367	29.9624	29.9405	29.3807	29.3238	29.4553	30.066
	10	3004.627	29.94	39.935	29.6147	30.2449	32.2549	29.92937	29.7261	31.2369	31.4009	31.3406	29.9529	29.9659	29.9617	29.9141	29.9634	29.9392	29.3831	29.3243	29.4546	30.063
	11	3510.908	29.94	39.935	29.6862	30.4045	33.0403	29.93008	29.6508	31.8035	31.9485	31.8742	29.957	29.9799	29.9814	29.91414	29.9715	29.948	29.1798	29.1028	29.2625	30.108
	12	3517.886	29.94	39.935	29.6919	30.4065	33.0404	29.9272	29.644	31.8055	31.9469	31.8638	29.9532	29.9795	29.9786	29.91275	29.9711	29.9476	29.1801	29.1015	29.267	30.11
	13	3993.239	29.94	39.935	29.7187	30.5391	33.9111	29.92884	29.5545	32.354	32.5736	32.444	29.9598	29.9924	29.9929	29.91112	29.9829	29.9503	28.9538	28.8505	29.0223	30.154
	14	3988.646	29.94	39.935	29.737	30.5374	33.8994	29.92828	29.5547	32.3544	32.5685	32.4453	29.9602	29.9906	29.9914	29.91176	29.9791	29.9471	28.9573	28.8558	29.0274	30.153
	15	4490.985	29.94	39.935	29.7543	30.7015	34.9704	29.92537	29.4444	33.0629	33.3692	33.1362	29.9678	30.0065	29.9963	29.90668	29.9963	29.9657	28.6742	28.5456	28.7912	30.203
	16	4495.224	29.94	39.935	29.7614	30.7079	34.9819	29.9249	29.4383	33.0786	33.3996	33.1498	29.9656	30.006	29.9981	29.90592	29.9912	29.9682	28.6648	28.5408	28.7971	30.2
	17	5009.101	29.94	39.94	29.7952	30.8968	36.161	29.93106	29.3243	33.8571	34.241	33.9541	29.9779	30.0261	30.0199	29.90483	30.009	30.0087	28.3834	28.2425	28.5254	30.254
	19	5009.728	29.94	39.935	29.8236	30.891	36.1528	29.92564	29.322	33.8325	34.2107	33.9476	29.9755	30.0232	30.012	29.8979	30.0001	30.0056	28.382	28.2368	28.5068	30.246

LP Cav opened HP Cav closed	Run #	RPM	PK	PL	Pin	Pin (Flange)	Pout (Flange)	Pout (Vena)	Tin CFF (2 o/c)	Tin CFF (11 o/c)	Tin TTR (8 o/c)	Tin TTR (5 o/c)	Tout TTR	Tin Orifice	Tout CFF (Bot)	Tout CFF (Mid)	Tout CFF (Top)	TTR Mass Flow (lbm/s)	Turbine Power (HP)	CFF Mass Flow (lbm/s)	Pi CFF	Tau CFF	CFF Efficiency	CFF Corrected Mass Flow
	1	1042.3852	29.9608	29.9608	33.2731	29.9821	33.2592	33.2456	529.0393	531.8958	535.5468	535.4677	533.8223	539.8288	532.0944	532.6358	532.3054	1.0495	-0.4244	0.9418	1.0059	1.0035	0.4755	0.9507
	2	1063.8977	29.9598	29.9599	33.2601	29.9603	33.2263	33.2340	528.3714	531.8149	535.8579	535.8315	534.1300	539.9624	531.8061	532.4354	532.2983	1.0217	-0.4205	0.8395	1.0065	1.0039	0.4739	0.8472
	3	1492.4446	29.9586	29.9588	33.1620	29.9585	33.1266	33.1284	527.7930	532.1788	536.9038	536.8300	534.3585	539.1327	532.6552	533.7538	533.8663	1.1565	-0.6962	0.8435	1.0130	1.0065	0.5695	0.8515
	4	1502.9345	29.9588	29.9591	33.1461	29.9595	33.1054	33.1277	531.3139	533.1087	536.9811	536.9020	534.3971	539.1643	535.4677	535.9440	535.3200	0.8623	-0.5266	0.6518	1.0130	1.0063	0.5832	0.6594
	5	2008.6776	29.9550	29.9546	34.8513	29.9544	34.8059	34.8329	530.8341	532.4829	537.2202	537.1798	533.4339	538.8585	536.8950	537.7089	537.4768	0.8836	-0.7986	0.5836	1.0241	1.0107	0.6356	0.5906
	6	2016.3596	29.9531	29.9527	34.8666	29.9520	34.8198	34.8552	531.0503	532.0171	537.2378	537.2132	533.4391	538.8550	536.6770	537.3714	536.9688	0.7006	-0.6366	0.4848	1.0240	1.0103	0.6592	0.4905
	7	2499.2816	29.9503	29.9498	34.8871	29.9489	34.8227	34.8189	531.2753	532.7430	537.8846	537.8565	532.3247	540.7903	539.4930	540.9116	540.8360	1.6768	-2.2319	1.1065	1.0389	1.0158	0.6947	1.1215
	8	2509.5469	29.9502	29.9498	34.8960	29.9490	34.8492	34.8487	532.0927	532.9645	537.9743	537.9251	532.4688	540.6567	540.0819	541.4389	541.2438	1.3993	-1.8406	0.9138	1.0386	1.0158	0.6907	0.9265
	9	3003.2288	29.9457	29.9454	35.7565	29.9440	35.6730	35.6639	531.7182	532.8415	538.2362	538.2028	530.7919	540.2577	543.2583	545.0161	544.7964	1.9750	-3.5207	1.2147	1.0553	1.0227	0.6827	1.2328
	10	2994.8191	29.9453	29.9446	35.7020	29.9440	35.6112	35.6334	531.5389	532.5514	538.3505	538.2802	530.8973	540.0696	542.5499	544.4272	544.5889	1.7022	-3.0304	1.0692	1.0553	1.0222	0.6987	1.0850
	11	3502.6274	29.9507	29.9506	37.5513	29.9490	37.4902	37.4930	531.5407	532.3300	538.6177	538.6054	528.8987	539.6636	546.3134	548.8763	549.1874	1.6102	-3.7536	0.9660	1.0775	1.0304	0.7081	0.9818
	12	3512.8603	29.9494	29.9496	37.6040	29.9486	37.5273	37.5174	531.5249	532.0048	538.5966	538.5930	528.8249	539.8130	546.6157	549.0643	549.2542	1.9597	-4.5950	1.1571	1.0775	1.0311	0.6928	1.1758
	13	4007.9899	29.9480	29.9481	39.6877	29.9463	39.5853	39.5965	532.1647	531.9837	538.7407	538.7706	526.3692	539.8815	550.8907	554.0776	554.5188	2.0641	-6.1359	1.2124	1.1025	1.0396	0.7132	1.2346
	14	4006.9728	29.9479	29.9476	39.7161	29.9464	39.5845	39.5863	531.6725	531.4036	538.7794	538.7618	526.4237	539.9395	550.9645	553.7665	554.3079	2.4584	-7.2848	1.4134	1.1031	1.0404	0.7036	1.4386
	15	4514.6394	29.9461	29.9458	39.6241	29.9434	39.4695	39.4458	531.7481	531.0485	538.8497	538.8444	523.4636	539.9905	556.0604	559.7852	560.6044	2.8722	-10.6043	1.6115	1.1315	1.0516	0.6962	1.6433
	16	4505.6213	29.9455	29.9453	39.6006	29.9437	39.4497	39.4610	531.4546	531.0520	538.9112	538.8989	523.5216	539.9940	555.9743	559.7975	560.6114	2.5451	-9.3966	1.4216	1.1314	1.0518	0.6927	1.4496
	17	4986.2469	29.9429	29.9430	41.6832	29.9408	41.4976	41.5125	529.8550	529.2766	539.0729	539.0975	520.5210	540.2471	559.0751	564.3046	565.1132	2.8833	-12.8463	1.6091	1.1634	1.0628	0.7034	1.6420
	18	5001.0844	29.9428	29.9428	41.6911	29.9405	41.5016	41.5304	530.5458	529.6282	539.2294	539.2294	520.6089	540.3790	560.1368	565.0411	565.6388	2.7978	-12.5031	1.5543	1.1639	1.0632	0.7008	1.5869
	19	3005.8918	29.9529	29.9529	36.9022	29.9520	36.8500	36.8460	533.7626	534.4147	539.3384	539.2645	531.9925	540.3755	545.1831	547.0147	546.9901	1.5667	-2.7483	0.9304	1.0559	1.0230	0.6793	0.9459
	20	2997.6321	29.9514	29.9507	36.9158	29.9499	36.8476	36.8349	533.0981	533.5604	539.1854	539.1538	531.9643	540.1364	544.4729	546.1727	546.1552	1.8761	-3.2443	1.1016	1.0552	1.0230	0.6727	1.1191

LP_Cav closed HP Cav opened	Run #	RPM	PK	PL	Pin	Pin (Flange)	Pout (Flange)	Pout (Vena)	Tin CFF (2 o/c)	Tin CFF (11 o/c)	Tin TTR (8 o/c)	Tin TTR (5 o/c)	Tout TTR	Tin Orifice	Tout CFF (Bot)	Tout CFF (Mid)	Tout CFF (Top)	TTR Mass Flow (lbm/s)	Turbine Power (HP)	CFF Mass Flow (lbm/s)	Pi CFF	Tau CFF	CFF Efficiency	CFF Corrected Mass Flow
	1	1165.8749	29.938	29.9387	33.3451	29.952	33.304	33.338	528.138	529.99	534.884	534.786	532.982	540.047	531.4405	531.578	530.5845	0.5571	-0.2477	0.483	1.007	1.004	0.464	0.487
	2	1189.7539	29.937	29.9373	33.3263	29.946	33.318	33.318	524.942	529.878	535.496	535.434	533.56	539.732	528.969	530.105	530.1098	0.5884	-0.2689	0.483	1.007	1.004	0.466	0.487
	3	1489.2403	29.934	29.934	33.2492	29.945	33.233	33.224	524.645	529.553	535.997	535.955	533.487	540.221	530.4526	531.259	530.8007	1.004	-0.5998	0.668	1.011	1.007	0.459	0.673
	4	1507.4355	29.934	29.9336	33.2802	29.95	33.211	33.268	525.45	530.161	536.299	536.229	533.715	540.813	530.3173	531.541	531.2841	0.6991	-0.4277	0.55	1.011	1.006	0.523	0.554
	5	1994.8335	29.929	29.9295	34.7826	29.929	34.734	34.758	527.617	531.11	536.612	536.508	533.045	539.395	534.2846	535.174	534.3339	1.0057	-0.8484	0.675	1.021	1.01	0.603	0.682
	6	2045.8894	29.93	29.9301	34.9381	29.93	34.883	34.884	527.157	530.047	536.726	536.652	533.081	540.038	533.3829	534.255	533.7802	1.5037	-1.3024	1.043	1.021	1.01	0.609	1.053
	7	2498.4178	29.927	29.9267	36.7842	29.926	36.763	36.757	528.871	531.21	537.37	537.305	532.381	541.449	536.4608	537.581	536.8493	1.0895	-1.296	0.78	1.034	1.013	0.73	0.789
	8	2501.6472	29.927	29.9262	36.8065	29.926	36.75	36.751	528.988	531.506	537.436	537.366	532.469	540.984	536.9987	538.222	537.2835	1.5553	-1.8411	1.057	1.034	1.014	0.696	1.07
	9	3003.349	29.925	29.9243	36.6762	29.924	36.618	36.611	527.58	529.793	537.523	537.407	530.794	539.676	538.3083	539.743	538.978	1.6794	-2.6887	1.085	1.05	1.02	0.72	1.098
	10	3004.6273	29.923	29.9224	36.6964	29.921	36.626	36.624	529.713	531.527	537.588	537.505	530.882	540.01	540.2823	541.72	540.5179	1.7726	-2.8353	1.156	1.05	1.019	0.732	1.172
	11	3510.9077	29.924	29.9238	38.7799	29.923	38.711	38.725	527.802	531.187	538.28	538.234	529.512	540.495	542.1333	544.666	543.6204	1.5927	-3.3428	0.996	1.07	1.026	0.739	1.01
	12	3517.886	29.924	29.9234	38.7823	29.922	38.726	38.735	529.5	531.989	538.549	538.47	529.72	541.376	544.6821	546.617	544.9054	1.4712	-3.1036	0.882	1.07	1.028	0.707	0.896
	13	3993.2387	29.922	29.9223	38.5937	29.92	38.495	38.495	531.175	531.695	538.748	538.693	527.732	541.186	549.103	551.028	548.7796	2.1119	-5.5699	1.275	1.091	1.034	0.738	1.297
	14	3988.6462	29.922	29.922	38.5731	29.92	38.495	38.485	531.889	532.174	538.648	538.618	527.684	540.511	550.3001	551.974	549.4229	2.0013	-5.2588	1.182	1.091	1.035	0.725	1.203
	15	4490.985	29.919	29.919	40.5907	29.916	40.48	40.475	528.848	530.129	538.662	538.653	525	540.488	551.7186	554.798	552.4798	2.3421	-7.6767	1.361	1.118	1.044	0.73	1.384
	16	4495.2245	29.918	29.9178	40.617	29.915	40.507	40.433	531.941	531.47	538.915	538.887	525.228	541.325	555.0286	557.194	553.9581	2.9509	-9.683	1.703	1.119	1.045	0.732	1.737
	17	5009.1008	29.92	29.9197	40.171	29.917	39.998	39.994	530.903	530.24	539.359	539.293	522.557	541.613	558.0714	561.362	558.3333	2.8786	-11.585	1.683	1.148	1.054	0.745	1.717
	19	5009.7283	29.914	29.9137	40.1033	29.912	39.969	39.988	529.147	529.767	539.402	539.374	522.625	541.581	557.1977	561.084	558.1979	2.3254	-9.3552	1.327	1.148	1.055	0.723	1.353

LP Cav opened HP Cav closed	Run #	RPM	Corrected Power (HP)	Corrected Speed (RPM)	X1	mdot1	X2	mdot2	X3	mdot3	Computed MA Mdot	Computed MA HP	Corrected Computed MA Mdot(lbm/s)	Corrected Computed MA HP	Pt_bar	Tt_bar	Mach Exit	Temp Exit	Velocity Exit	Corrected Thrust
	1	1042.3852	0.5933	1031.7516	0.0386	0.1334	0.0390	0.0771	0.0405	0.1403	0.3507	0.2174	0.3544	0.2148	30.1239	532.2936	0.0985	530.2339	33.9255	9.8018
	2	1063.8977	0.5880	1053.4166	0.0406	0.1406	0.0410	0.0809	0.0425	0.1472	0.3688	0.2552	0.3725	0.2523	30.1409	532.1319	0.1026	529.9026	35.2950	10.7181
	3	1492.4446	0.9742	1477.8910	0.0579	0.2003	0.0578	0.1144	0.0589	0.2039	0.5186	0.5950	0.5240	0.5884	30.3205	533.3652	0.1379	529.3359	47.4502	20.2624
	4	1502.9345	0.7353	1485.1639	0.0579	0.2001	0.0579	0.1142	0.0586	0.2026	0.5168	0.5798	0.5234	0.5722	30.3183	535.5157	0.1376	531.4918	47.4188	20.2224
	5	2008.6776	1.1167	1985.9587	0.0790	0.2734	0.0788	0.1557	0.0780	0.2700	0.6991	1.3399	0.7082	1.3241	30.6243	537.3038	0.1826	530.2307	62.8680	36.2476
	6	2016.3596	0.8904	1993.7879	0.0789	0.2730	0.0786	0.1553	0.0776	0.2686	0.6969	1.2805	0.7058	1.2656	30.6182	536.9461	0.1818	529.9373	62.5817	35.9612
	7	2499.2816	3.1236	2470.1993	0.1025	0.3549	0.0991	0.1960	0.0960	0.3323	0.8832	2.5002	0.8960	2.4730	31.0343	540.3475	0.2292	529.2313	78.8140	57.4262
	8	2509.5469	2.5746	2479.1352	0.1021	0.3535	0.0989	0.1955	0.0954	0.3303	0.8792	2.4841	0.8923	2.4556	31.0266	540.8507	0.2284	529.7981	78.5883	57.0309
	9	3003.2288	4.9319	2967.5275	0.1194	0.4139	0.1183	0.2341	0.1148	0.3980	1.0460	4.2544	1.0627	4.2119	31.4808	544.2603	0.2705	528.7828	92.9984	80.2704
	10	2994.8191	4.2464	2959.8704	0.1198	0.4154	0.1180	0.2337	0.1148	0.3981	1.0472	4.1710	1.0637	4.1306	31.4812	543.7776	0.2705	528.3101	92.9684	80.3169
	11	3502.6274	5.2685	3462.1102	0.1410	0.4896	0.1392	0.2761	0.1341	0.4662	1.2319	6.7310	1.2532	6.6770	32.0889	548.0300	0.3178	526.7529	109.0389	110.8044
	12	3512.8603	6.4507	3472.7813	0.1411	0.4900	0.1389	0.2754	0.1345	0.4673	1.2327	6.8831	1.2539	6.8290	32.0911	548.2115	0.3179	526.9068	109.1096	110.9363
	13	4007.9899	8.6274	3961.1097	0.1617	0.5628	0.1583	0.3145	0.1526	0.5314	1.4087	10.0323	1.4359	9.9691	32.7751	553.0517	0.3632	525.3320	124.4571	144.6444
	14	4006.9728	10.2479	3962.1012	0.1620	0.5639	0.1586	0.3154	0.1535	0.5344	1.4137	10.2635	1.4403	10.2039	32.7934	552.9234	0.3643	525.0471	124.8081	145.4911
	15	4514.6394	14.9498	4464.6697	0.1823	0.6359	0.1775	0.3535	0.1712	0.5971	1.5865	14.7109	1.6194	14.6571	33.5721	558.7117	0.4090	523.6754	139.9216	183.0234
	16	4505.6213	13.2503	4456.3596	0.1824	0.6361	0.1778	0.3540	0.1708	0.5958	1.5859	14.7707	1.6187	14.7203	33.5661	558.6877	0.4087	523.7048	139.8149	182.7927
	17	4986.2469	18.1862	4939.5817	0.1998	0.6993	0.1979	0.3957	0.1886	0.6608	1.7559	19.7264	1.7935	19.7364	34.4191	562.6584	0.4519	520.1749	154.0761	222.6689
	18	5001.0844	17.6921	4951.8442	0.2002	0.7004	0.1977	0.3951	0.1893	0.6625	1.7580	19.9005	1.7967	19.9013	34.4362	563.4309	0.4527	520.7465	154.4401	223.5777
	19	3005.8918	3.8433	2965.1251	0.1197	0.4140	0.1185	0.2341	0.1162	0.4021	1.0503	4.3554	1.0688	4.3046	31.4994	546.3038	0.2721	530.5915	93.7013	81.3441
	20	2997.6321	4.5400	2959.0818	0.1195	0.4136	0.1182	0.2337	0.1148	0.3977	1.0449	4.3242	1.0626	4.2767	31.4809	545.5189	0.2705	530.0050	93.1077	80.3621

LP_Cav closed HP Cav opened	Run #	RPM	Corrected Power (HP)	Corrected Speed (RPM)	X1	mdot1	X2	mdot2	X3	mdot3	Computed MA Mdot	Computed MA HP	Corrected Computed MA Mdot(lbm/s)	Corrected Computed MA HP	Pt_bar	Tt_bar	Mach Exit	Temp Exit	Velocity Exit	Corrected Thrust
	1	1165.8749	0.3470	1155.5114	0.0382	0.1321	0.0415	0.0820	0.0434	0.1500	0.3642	0.2592	0.3678	0.2567	30.1192	531.1608	0.0974	529.1524	33.5003	10.0364
	2.	1189.7539	0.3774	1181.0258	0.0400	0.1384	0.0435	0.0861	0.0456	0.1580	0.3825	0.2893	0.3857	0.2869	30.1357	529.6373	0.1014	527.4699	34.8012	10.9340
	3	1489.2403	0.8421	1478.7514	0.0514	0.1779	0.0547	0.1083	0.0567	0.1965	0.4828	0.6004	0.4868	0.5958	30.2538	530.7620	0.1260	527.4128	43.2607	17.1498
	4	1507.4355	0.6001	1495.8161	0.0511	0.1771	0.0541	0.1070	0.0564	0.1956	0.4797	0.5116	0.4841	0.5074	30.2493	530.9470	0.1251	527.6420	42.9748	16.9399
	5	1994.8335	1.1895	1976.5416	0.0701	0.2426	0.0747	0.1478	0.0751	0.2603	0.6507	1.1358	0.6580	1.1254	30.5144	534.5051	0.1679	528.5472	57.6991	30.8956
	6	2045.8894	1.8274	2028.5899	0.0704	0.2438	0.0749	0.1482	0.0757	0.2626	0.6547	1.1394	0.6616	1.1299	30.5189	533.7282	0.1685	527.7344	57.8733	31.1569
	7	2498.4178	1.8175	2473.9273	0.0899	0.3116	0.0942	0.1866	0.0939	0.3259	0.8240	1.9081	0.8346	1.8912	30.8662	536.8612	0.2114	527.4354	72.5748	49.2441
	8	2501.6472	2.5816	2476.6425	0.0901	0.3122	0.0937	0.1854	0.0940	0.3261	0.8236	1.9949	0.8343	1.9770	30.8663	537.3820	0.2114	527.9468	72.6108	49.2519
	9	3003.3490	3.7798	2977.7134	0.1089	0.3780	0.1156	0.2295	0.1130	0.3931	1.0006	3.4660	1.0132	3.4435	31.3113	538.8902	0.2556	525.1620	87.5858	72.0716
	10	3004.6273	3.9788	2973.5505	0.1092	0.3785	0.1157	0.2294	0.1134	0.3936	1.0015	3.4276	1.0161	3.3994	31.3152	540.7007	0.2560	526.8888	87.8522	72.4903
	11	3510.9077	4.7019	3478.2836	0.1302	0.4524	0.1350	0.2682	0.1325	0.4615	1.1821	5.5309	1.1995	5.4980	31.8640	543.2770	0.3012	524.2485	103.1164	100.3177
	12	3517.8860	4.3610	3481.0912	0.1304	0.4525	0.1351	0.2678	0.1323	0.4597	1.1800	5.7937	1.1990	5.7534	31.8603	545.2070	0.3010	526.1451	103.2068	100.3475
	13	3993.2387	7.8328	3948.9029	0.1474	0.5124	0.1537	0.3052	0.1500	0.5217	1.3393	8.1763	1.3638	8.1262	32.4391	549.4179	0.3418	524.8897	117.0734	129.2813
	14	3988.6462	7.3912	3942.1518	0.1474	0.5121	0.1535	0.3046	0.1500	0.5212	1.3379	8.3187	1.3632	8.2631	32.4385	550.3454	0.3418	525.7810	117.1598	129.3183
	15	4490.9850	10.8361	4449.2798	0.1664	0.5802	0.1739	0.3467	0.1682	0.5874	1.5143	11.9408	1.5421	11.9122	33.1615	552.7154	0.3862	521.6016	131.8565	164.3314
	16	4495.2245	13.6412	4444.1835	0.1669	0.5811	0.1747	0.3476	0.1686	0.5871	1.5157	12.0457	1.5469	11.9930	33.1798	555.1148	0.3872	523.7054	132.4816	165.6117
	17	5009.1008	16.3683	4957.5176	0.1848	0.6456	0.1931	0.3855	0.1870	0.6538	1.6849	16.2188	1.7209	16.1946	33.9826	558.9247	0.4304	520.3683	146.7823	203.7548
	19	5009.7283	13.2331	4963.3541	0.1844	0.6439	0.1925	0.3844	0.1869	0.6539	1.6822	16.5680	1.7165	16.5628	33.9637	558.4687	0.4294	520.1035	146.4177	202.6990

A2. TEST 2: TWO CAVITIES OPENED

Run #	RPM	Patm	Pcal	Pin TTR (5 o/c)	Pout TTR	Pin TTR (8 o/c)	Pin CFF (2 o/c)	Pin CFF (10 o/c)	Pout CFF (Top)	Pout CFF (Mid)	Pout CFF (Bot)	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
1	2029.3788	29.90	39.90	30.1101	30.1427	31.5586	29.8586	29.8297	30.5909	30.6524	30.6294	29.7876	29.0900	29.3215	29.6497	29.8573	29.7837	29.5992	29.5701	29.6572	29.9546	29.8911	29.8868
2	2031.1444	29.90	39.90	30.1357	30.1471	31.5559	29.8592	29.8295	30.5997	30.6573	30.6330	29.7871	29.0831	29.3170	29.6480	29.8585	29.7839	29.6000	29.5693	29.6606	29.9549	29.8912	29.8869
3	2024.6127	29.90	39.90	30.1514	30.1392	31.5212	29.8584	29.8304	30.5791	30.6354	30.6278	29.7926	29.1075	29.3319	29.6544	29.8574	29.7824	29.6054	29.5732	29.6836	29.9518	29.8867	29.8820
4	2023.8887	29.90	39.90	30.1554	30.1586	31.5159	29.8587	29.8306	30.5899	30.6435	30.6179	29.7924	29.0996	29.3264	29.6516	29.8580	29.7814	29.6016	29.5738	29.6632	29.9543	29.8872	29.8829
5	2017.2069	29.90	39.90	30.1622	30.1358	31.4288	29.8599	29.8335	30.5766	30.6381	30.6287	29.8650	29.1968	29.4114	29.7044	29.8821	29.7881	29.6446	29.6181	29.7218	29.9817	29.8838	29.8796
6	2028.0412	29.90	39.90	30.1722	30.1356	31.4275	29.8608	29.8360	30.5757	30.6427	30.6282	29.8668	29.1994	29.4146	29.7042	29.8852	29.7906	29.6436	29.6190	29.7281	29.9857	29.8863	29.8823
7	2039.0132	29.90	39.90	30.1946	30.0898	31.1386	29.8734	29.8560	30.5609	30.6328	30.5722	30.0982	29.5356	29.6818	29.8342	29.9209	29.8238	29.7951	29.7669	29.8839	30.0682	29.8844	29.8812
8	2050.2728	29.90	39.90	30.2014	30.0816	31.1401	29.8724	29.8546	30.5649	30.6270	30.5855	30.0986	29.5377	29.6807	29.8342	29.9219	29.8208	29.7943	29.7670	29.8818	30.0676	29.8837	29.8803
9	2022.0812	29.90	39.90	30.2006	29.9751	30.6070	29.8906	29.8881	30.0940	30.0915	30.0868	30.0430	29.4570	29.3430	29.3907	29.4980	29.8778	29.5018	29.4791	29.5706	29.7889	29.8811	29.8784
10	2039.4846	29.90	39.90	30.2038	29.9765	30.6062	29.8928	29.8910	30.0923	30.0988	30.0900	30.0497	29.4586	29.3465	29.3867	29.4953	29.8806	29.5037	29.4743	29.5637	29.7891	29.8856	29.8834
11	2025.8842	30.00	39.97	30.0809	30.2097	31.3487	29.9430	29.9234	30.6489	30.7101	30.6892	30.0677	29.4450	29.6572	29.9170	30.0743	29.8878	29.8144	29.7851	29.9420	30.1164	29.9731	29.9661
12	2040.0393	30.00	39.97	30.0834	30.2072	31.3460	29.9438	29.9228	30.6610	30.7241	30.6858	30.0691	29.4394	29.6584	29.9162	30.0760	29.8906	29.8169	29.7889	29.9440	30.1191	29.9783	29.9708
13	2002.9378	30.00	39.97	30.0572	30.1375	31.0597	29.9548	29.9412	30.6008	30.6925	30.6221	30.2530	29.7560	29.8721	29.9895	30.0518	29.9233	29.9874	29.9604	30.0963	30.1700	29.9813	29.9734
14	2018.0821	30.00	39.97	30.0594	30.1399	31.0683	29.9542	29.9400	30.6025	30.6982	30.6299	30.2549	29.7531	29.8703	29.9931	30.0532	29.9216	29.9892	29.9592	30.0972	30.1706	29.9813	29.9734
15	2005.8841	30.00	39.97	30.0445	30.0608	30.7049	29.9638	29.9622	30.3048	30.3493	30.3170	30.1775	29.6637	29.5972	29.6035	29.6349	29.9600	29.6440	29.6191	29.7235	29.9525	29.9713	29.9686
16	2034.8228	30.00	39.97	30.0493	30.0624	30.7038	29.9634	29.9627	30.2990	30.3389	30.3118	30.1756	29.6725	29.6006	29.6056	29.6388	29.9627	29.6417	29.6122	29.7229	29.9549	29.9751	29.9725
1	3033.7813	29.90	39.90	30.2588	30.5488	33.3624	29.8149	29.7518	31.5697	31.6677	31.5942	29.6581	28.0120	28.5480	29.3034	29.7788	29.6444	29.2164	29.1557	29.2684	30.0148	29.8922	29.8839
2	3036.3914	29.90	39.90	30.2663	30.5426	33.3573	29.8142	29.7487	31.5644	31.6914	31.6011	29.6570	27.9985	28.5427	29.3006	29.7762	29.6437	29.2101	29.1525	29.2657	30.0174	29.8905	29.8827
3	3021.0875	29.90	39.90	30.2793	30.5328	33.3017	29.8150	29.7514	31.5408	31.6578	31.5576	29.6745	28.0566	28.5779	29.3202	29.7883	29.6460	29.2269	29.1689	29.2845	30.0193	29.8876	29.8792
4	3018.5339	29.90	39.90	30.2880	30.5331	33.3013	29.8156	29.7508	31.5536	31.6571	31.5707	29.6755	28.0591	28.5815	29.3233	29.7883	29.6490	29.2298	29.1730	29.2818	30.0189	29.8885	29.8809
5	3018.8984	29.90	39.90	30.3016	30.4738	33.0877	29.8214	29.7644	31.5106	31.6472	31.5869	29.8449	28.2897	28.7669	29.4334	29.8444	29.6655	29.3267	29.2669	29.3932	30.0888	29.8849	29.8769
6	3012.2148	29.90	39.90	30.3107	30.4755	33.0925	29.8220	29.7632	31.5105	31.6378	31.5851	29.8447	28.2992	28.7738	29.4365	29.8477	29.6666	29.3311	29.2689	29.3914	30.0860	29.8864	29.8780
11	3022.7007	30.00	39.97	30.1345	30.4737	32.8591	29.9096	29.8584	31.5589	31.7588	31.5788	30.1929	28.6984	29.2105	29.8347	30.1978	29.7843	29.5787	29.5058	29.7707	30.2810	29.9823	29.9600
12	3063.6633	30.00	39.97	30.1262	30.4796	32.8776	29.9102	29.8624	31.5581	31.7378	31.5798	30.1945	28.7051	29.2135	29.8394	30.2066	29.7875	29.5832	29.5213	29.7738	30.2752	29.9836	29.9642
7	2995.3872	29.90	39.90	30.3350	30.2913	32.3805	29.8455	29.8066	31.3672	31.6087	31.3882	30.3493	29.0557	29.3849	29.7517	29.9487	29.7369	29.6572	29.5952	29.7882	30.2663	29.8850	29.8780
8	3003.2888	29.90	39.90	30.3416	30.2927	32.3829	29.8471	29.8056	31.3676	31.5957	31.4048	30.3489	29.0644	29.3878	29.7550	29.9495	29.7371	29.6558	29.5982	29.7946	30.2729	29.8851	29.8786
13	3010.8997	30.00	39.97	30.1193	30.3135	32.1746	29.9299	29.8999	31.4521	31.6410	31.4509	30.6149	29.4211	29.7043	30.0060	30.1599	29.8481	29.9606	29.8927	30.1947	30.4000	29.9775	29.9598
14	3020.1141	30.00	39.97	30.1185	30.3199	32.2021	29.9329	29.8990	31.4786	31.6633	31.4668	30.6278	29.4157	29.7053	30.0150	30.1768	29.8517	29.9646	29.8967	30.2025	30.4119	29.9826	29.9656
15	3012.3509	30.00	39.97	30.0949	30.1261	31.3213	29.9557	29.9531	30.7474	30.8317	30.7557	30.4563	29.2452	29.0810	29.1046	29.1863	29.9441	29.1834	29.0990	29.3148	29.9206	29.9639	29.9628
16	3024.3920	30.00	39.97	30.0998	30.1273	31.3204	29.9573	29.9534	30.7504	30.8393	30.7642	30.4515	29.2464	29.0780	29.0921	29.1990	29.9464	29.1679	29.1230	29.3426	29.9247	29.9711	29.9692
9	3011.6704	29.90	39.90	30.3367	30.0272	31.1291	29.8864	29.8825	30.4003	30.4082	30.3844	30.2704	29.0086	28.7926	28.8716	29.0466	29.8706	29.0769	29.0248	29.2044	29.7064	29.8770	29.8744
10	3012.1845	29.90	39.90	30.3356	30.0286	31.1222	29.8890	29.8847	30.4014	30.4160	30.3882	30.2767	29.0004	28.7892	28.8701	29.0484	29.8752	29.0853	29.0302	29.2122	29.7137	29.8830	29.8805
1	4022.8504	29.90	39.90	30.3482	30.9900	35.8372	29.7561	29.6421	32.9367	33.1507	32.9292	29.5179	26.6056	27.4668	28.7768	29.6153	29.4750	28.6988	28.5958	28.7492	30.1131	29.8882	29.8779
2	4029.7130	29.90	39.90	30.3613	30.9986	35.8390	29.7569	29.6418	32.9538	33.1847	32.9044	29.5197	26.6002	27.4676	28.7761	29.6233	29.4756	28.7030	28.5920	28.7707	30.1208	29.8914	29.8814
3	4015.7959	29.90	39.90	30.3744	30.9928	35.7835	29.7574	29.6459	32.9300	33.1581	32.9154	29.5432	26.6472	27.5051	28.7990	29.6337	29.4782	28.7198	28.6103	28.7875	30.1226	29.8903	29.8801
4	4006.2771	29.90	39.90	30.3838	30.9941	35.7897	29.7596	29.6536	32.9291	33.1683	32.9317	29.5457	26.6406	27.5021	28.7983	29.6375	29.4781	28.7272	28.6197	28.7694	30.1269	29.8926	29.8827
5	4014.2107	29.90	39.90	30.3988	30.8989	35.4530	29.7677	29.6673	32.8646	33.1092	32.8667	29.8170	27.0119	27.8168	28.9820	29.7388	29.5092	28.8733	28.7658	28.9608	30.2309	29.8890	29.8781
6	4007.1869	29.90	39.90	30.4088	30.8993	35.4592	29.7678	29.6656	32.8715	33.0993	32.8907	29.8224	27.0115	27.8188	28.9903	29.7418	29.5139	28.8780	28.7716	28.9534	30.2346	29.8907	29.8809
7	4013.7813	29.90	39.90	30.4267	30.6020	34.2773	29.8065	29.7310	32.7133	33.0077	32.5919	30.7188	28.2920	28.8864	29.5538	29.9357	29.6133	29.4363	29.3398	29.6259	30.5561	29.8879	29.8770
8	4005.6618	29.90	39.90	30.4393	30.6091	34.2914	29.8083	29.7352	32.7305	33.0002	32.6586	30.7230	28.2874	28.8900	29.5569	29.9340	29.6195	29.4460	29.3443	29.6283	30.5594	29.8909	29.8815
9	4006.0362	29.90	39.90	30.4352	30.0903	31.8393	29.8839	29.8777	30.8280	30.8339	30.8014	30.6019	28.2958	27.9795	28.1006	28.4061	29.8604	28.4819	28.3903	28.6305	29.5973	29.8798	29.8786
10	4017.3823	29.90	39.90	30.4304	30.0902	31.8293	29.8859	29.8800	30.8093	30.8289	30.7925	30.6074	28.3132	27.9965	28.1062	28.4297	29.8649	28.5000	28.3874	28.6221	29.6060	29.8839	29.8826
11	4044.7900	29.97	39.97	30.1456	30.8517	35.0549	29.8652	29.7782	32.9647	33.1968	32.8295	30.3879	27.6156	28.4974	29.6500	30.3403	29.6355	29.2534	29.1385	29.5270	30.5160	29.9764	29.9572
12	4039.9693	29.97	39.97	30.1621	30.8518	35.0880	29.8634	29.7743	32.9986	33.2065	32.8168	30.3954	27.5946	28.5007	29.6471	30.3523	29.6489	29.2530	29.1371	29.5152	30.5198	29.9753	29.9614
13	4029.9296	29.97	39.97	30.1587	30.5780	33.8682	29.8967	29.8377	32.7594	33.0119	32.6555	31.1236	28.8423	29.3932	29.9955	30.3047	29.7499	29.8863	29.7668	30.3132	30.7336	29.9747	29.9584
14	4015.4197	29.97	39.97	30.1518	30.5883	33.8943	29.8969	29.8382	32.8005	33.0639	32.6784	31.1326	28.8361	29.3901	29.9960	30.3130	29.7461	29.8951	29.7744	30.3293	30.7433	29.9771	29.9617
15	4030.3627	29.97	39.97	30.1562	30.2008	32.1356	29.9452	29.9380	31.4213	31.5658	31.3945	30.8607	28.6920	28.4073	28.4498	28.6184	29.9280	28.6063	28.4992	28.8010	29.8875	29.9593	29.9580
16	4023.3629	29.97	39.97	30.1440	30.2005	32.1472	29.9470	29.9399	31.4339	31.5789	31.4173	30.8629	28.6981	28.4065	28.4574	28.6019	29.9298	28.6259	28.5157	28.7982	29.8916	29.9623	29.9620
1	5022.4767	29.90	39.90	30.4544	31.5693	39.0977	29.6874	29.5202	34.6622	35.0185	34.6856	29.4100	24.9255	26.0899	28.0146	29.3097	29.2601	28.0665	27.9098	28.1662	30.2507	29.8999	29.8817
2	5021.8460	29.90	39.90	30.4663	31.5757	39.1224	29.6864	29.5209	34.6597	35.0716	34.7581	29.4112	24.9081	26.0664	28.0106	29.3099	29.2605	28.0661	27.9120	28.1617	30.2570	29.9031	29.8845
3	5020.9216	29.90	39.90	30.4860	31.5437	38.9900	29.6895	29.5242	34.6216	34.9865	34.7284	29.4464	24.9772	26.1316	28.0438	29.3325	29.2657	28.0828	27.9309	28.1903	30.2596	29.9001	29.8813
4	5027.9479	29.90	39.90	30.4983	31.5425	38.9811	29.6907	29.5242	34.6437	35.0221	34.7312	29.4489	24.9739	26.1299	28.0403	29.3288	29.2721	28.0934	27.9447	28.2055	30.2616	29.9022	29.8842
5	5018.7371	29.90	39.90	30.5110	31.4155	38.5309	29.7027	29.5465	34.5846	34.9565	34.6816	29.8423	25.4470	26.5562	28.3332	29.4993	29.3049	28.3025	28.1538	28.4162	30.4176	29.9000	29.8815
6	5009.8954	29.90	39.90	30.5238	31.4205	38.5420	29.7030	29.5492	34.6051	34.9884	34.6889	29.8453	25.4551	26.5647	28.3286	29.4996	29.3066	28.3040	28.1525	28.4102	30.4197	29.9033	29.8839
7	4993.3429	29.90	39.90	30.5362	30.9746	36.6555	29.7607	29.6486	34.2499	34.9395	34.1137	31.2425	27.4240	28.2906	29.2569	29.7929	29.4719	29.2199	29.0615	29.5709	30.9315	29.8932	29.8790
8	4987.3660	29.90	39.90	30.5456	30.9788	36.6828	29.7617	29.6448	34.2285	34.9531	34.2218	31.2448	27.4149	28.2939	29.2549	29.7881	29.4729	29.2183	29.0716	29.5714	30.9231	29.8943	29.8798
9	5010.3139	29.90	39.90	30.5180	30.1696	32.7296	29.8804	29.8713	31.2898	31.3164	31.2782	31.0014	27.4295	26.9416	27.1565	27.6202	29.8508	27.7541	27.5971	27.9656	29.4193	29.8813	29.8800
10	5007.6372	29.90	39.90	30.5113	30.1709	32.7265	29.8821	29.8730	31.2913	31.3347	31.2880	31.0092	27.4208	26.9527	27.1451	27.6179	29.8538	27.7671	27.6125	27.9602	29.4309	29.8858	29.8844
11	5034.4029	29.97	39.97	30.2228	31.3323	38.0017	29.8011	29.6610	34.6614	35.1638	34.5871	30.6383	26.2315	27.4892	29.2528	30.3588	29.4400	28.8043	28.6311	29.1114	30.7939	29.9534	29.9485
12	5020.9216	29.97	39.97	30.2483	31.3352	38.0206	29.8040	29.6628	34.6902	35.1851	34.6070	30.6442	26.2195	27.4809	29.2546	30.3666	29.4429	28.8041	28.6427	29.0886	30.8056	29.9592	29.9556
13	5008.3901	29.97	39.97	30.2302	30.9221	36.1448	29.8566	29.7605	34.4209	35.0708	34.2873	31.8595	28.1567	28.9711	29.8839	30.3789	29.6036	29.8390	29.6635	30.4842	31.1831	29.9719	29.9512
14	5020.2072	29.97	39.97	30.2301	30.9216	36.1340	29.8565	29.7588	34.4215	35.0707	34.2764	31.8511	28.1433	28.9730	29.8919	30.3794	29.6094	29.8364	29.6535	30.4845	31.1920	29.9746	29.9576
15	5025.3371	29.97	39.97	30.1960	30.3084	33.2384	29.9285	29.9185	32.2437	32.5277	32.2761	31.3808	27.9455	27.4975	27.5751	27.8679	29.9066	27.8584	27.6939	28.0846	29.8453	29.9560	29.9554
16	5027.9899	29.97	39.97	30.1843	30.3087	33.2381	29.9310	29.9207	32.2029	32.5053	32.2778	31.3706	27.9443	27.4803	27.5879	27.8832	29.9091	27.8583	27.7187	28.0696	29.8592	29.9614	29.9609
1	6021.8903	29.97	39.97	30.0985	32.3521	43.2678	29.6930	29.4610	37.4530	38.0691	37.0371	29.8005	23.2090	24.8109	27.5713	29.7210	29.1292	27.4901	27.2604	27.7883	30.6350	29.9629	29.9518
2	6032.0606	29.97	39.97	30.1117	32.3503	43.2921	29.6937	29.4622	37.4432	38.0601	37.0527	29.7968	23.2147	24.7961	27.5589	29.7112	29.1299	27.5017	27.2689	27.7890	30.6311	29.9731	29.9527
3	6063.9447	29.97	39.97	30.1315	32.3440	43.2387	29.6875	29.4644	37.4377	38.0807	37.0288	29.8296	23.2273	24.8057	27.5605	29.7020	29.1236	27.4995	27.2646	27.7720	30.6392	29.9595	29.9474
4	6010.4288	29.97	39.97	30.1486	32.3513	43.2680	29.6914	29.4653	37.4441	38.1346	37.1261	29.8351	23.2139	24.8087	27.5438	29.7010	29.1225	27.4977	27.2681	27.7915	30.6313	29.9565	29.9456
5	6038.7692	29.97	39.97	30.1870	32.1605	42.5564	29.7191	29.4923	37.2671	38.0495	36.8890	30.3516	23.8365	25.3709	27.9511	29.9447	29.1630	27.8023	27.5651	28.1489	30.8556	29.9400	29.9401
6	6032.9706	29.97	39.97	30.2027	32.1733	42.6551	29.7251	29.4961	37.2755	38.0128	36.8736	30.3582	23.8079	25.3560	27.9460	29.9447	29.1626	27.7975	27.5686	28.1501	30.8570	29.9483	29.9447
7	6055.0102	29.97	39.97	30.2501	31.9398	41.7901	29.7443	29.5239	37.1758	37.8758	36.8556	31.0724	24.6144	26.1682	28.5392	30.2350	29.1993	28.2129	27.9824	28.6265	31.0947	29.9136	29.9061
8	6054.7962	29.97	39.97	30.2623	31.9567	41.8369	29.7534	29.5235	37.2065	37.9004	36.7855	31.0796	24.6103	26.1658	28.5418	30.2381	29.2059	28.2266	27.9869	28.6548	31.1070	29.9225	29.9142
9	6028.1517	29.97	39.97	30.2574	31.5687	40.0862	29.7717	29.6044	36.7605	37.6688	36.3219	32.1895	26.3496	27.6735	29.3721	30.4376	29.3347	29.1294	28.8910	29.9314	31.4926	29.9346	29.9191
10	6036.6733	29.97	39.97	30.2603	31.5580	40.0171	29.7760	29.6134	36.7555	37.6489	36.3593	32.1985	26.3569	27.6705	29.3831	30.4403	29.3437	29.1315	28.8940	29.9393	31.5071	29.9467	29.9261
11	6024.5203	29.97	39.97	30.2520	31.2772	38.7448	29.8091	29.6758	36.3710	37.3330	36.2509	32.8933	27.5545	28.5877	29.7177	30.3738	29.4549	29.8491	29.5460	30.7304	31.6905	29.9567	29.9315
12	6021.1347	29.97	39.97	30.2373	31.2790	38.7343	29.8097	29.6706	36.3469	37.2964	36.3113	32.8944	27.5383	28.5916	29.7063	30.3699	29.4552	29.8289	29.5735	30.7171	31.6662	29.9535	29.9325
13	6053.3305	29.97	39.97	30.1897	30.4453	34.6665	29.9102	29.8939	33.2985	33.8011	33.3188	32.1087	27.0684	26.4858	26.5922	26.9950	29.8602	26.9989	26.7756	27.3118	29.7451	29.9368	29.9362
14	6058.1589	29.97	39.97	30.1924	30.4465	34.6739	29.9126	29.8957	33.3492	33.7949	33.2920	32.1293	27.0563	26.4872	26.5970	27.0220	29.8647	27.0140	26.7935	27.3477	29.7593	29.9445	29.9439
15	6023.7340	29.97	39.97	30.1773	30.3417	33.9230	29.9489	29.9358	31.9826	32.0006	32.0367	31.6650	26.3371	25.6694	26.0376	26.6750	29.9047	26.7353	26.5091	27.1482	29.1857	29.9428	29.9435
16	6029.9694	29.97	39.97	30.1718	30.3397	33.9233	29.9500	29.9379	31.9812	32.0143	32.0409	31.6598	26.3693	25.6901	26.0502	26.6670	29.8922	26.7347	26.4922	27.1145	29.2030	29.9500	29.9503

Run #	RPM	Pnoz1	Pnoz2	Pnoz3	Pin	Pin (Flange)	Pout (Flange)	Pout (Vena)	Tin CFF (2 o/c)	Tin CFF (11 o/c)	Tin TTR (8 o/c)	Tin TTR (5 o/c)	Tout TTR	Tin Orifice	Tout CFF (Bot)	Tout CFF (Mid)	Tout CFF (Top)	TTR Mass Flow (lbm/s)	Turbine Power (HP)	CFF Mass Flow (lbm/s)	Pi CFF	Tau CFF	CFF Efficiency
1	2029.3788	29.8438	29.8506	29.8377	35.3611	29.8879	35.3151	35.3178	532.7659	532.6710	535.6891	535.5432	531.1997	540.1610	538.2345	539.2030	539.1397	1.3505	-1.4315	0.9713	1.0261	1.0115	0.6419
2	2031.1444	29.8432	29.8513	29.8378	35.3407	29.8876	35.3002	35.2941	532.9979	532.8749	535.9370	535.8263	531.4985	539.0800	538.4999	539.4175	539.3735	1.4009	-1.4737	0.9967	1.0263	1.0116	0.6446
3	2024.6127	29.8389	29.8464	29.8337	35.2269	29.8816	35.1612	35.1836	533.2897	533.2194	536.8739	536.7456	532.4583	540.2788	538.8409	539.6671	539.6231	1.3475	-1.4072	0.9577	1.0258	1.0115	0.6360
4	2023.8887	29.8395	29.8465	29.8322	35.2046	29.8810	35.1760	35.1675	533.3354	533.2721	536.8651	536.7649	532.4917	539.4737	539.0061	539.7339	539.6055	1.2503	-1.2974	0.8797	1.0259	1.0115	0.6360
5	2017.2069	29.8403	29.8477	29.8343	34.9247	29.8797	34.8659	34.8893	533.4761	533.4708	537.4680	537.3766	533.1895	541.3792	539.0589	539.8077	539.5264	1.2144	-1.2337	0.8580	1.0257	1.0112	0.6485
6	2028.0412	29.8428	29.8494	29.8363	34.9436	29.8816	34.9108	34.8965	533.5358	533.6360	537.5630	537.4505	533.2511	541.0751	539.3067	540.0626	539.7866	1.3970	-1.4268	0.9694	1.0257	1.0115	0.6331
7	2039.0132	29.8546	29.8586	29.8503	33.9517	29.8806	33.9206	33.9262	533.6290	533.7028	537.7335	537.6421	534.0421	540.6145	539.1257	539.6600	538.9604	1.0219	-0.8941	0.6673	1.0242	1.0105	0.6563
8	2050.2728	29.8541	29.8574	29.8485	33.9776	29.8799	33.9241	33.9296	533.6132	533.4022	537.9444	537.8337	534.1968	541.5128	538.8093	539.2804	538.6388	1.3908	-1.2324	0.9506	1.0244	1.0101	0.6829
9	2022.0812	29.8760	29.8753	29.8740	33.1084	29.8764	33.0827	33.0998	534.0860	534.1809	537.9180	537.8354	535.5169	541.1841	539.1046	539.0641	538.1835	0.5964	-0.3378	0.3026	1.0067	1.0087	0.2206
10	2039.4846	29.8812	29.8802	29.8788	33.1146	29.8813	33.0841	33.1153	534.0104	534.1177	537.9919	537.9128	535.5854	541.4636	539.1485	539.1204	538.2679	0.1880	-0.1068	0.0931	1.0067	1.0090	0.2149
11	2025.8842	29.9357	29.9425	29.9307	33.3486	29.9680	33.3093	33.2861	524.9964	525.1511	536.3624	536.2850	532.3001	540.6128	531.4721	532.1384	531.3948	1.5708	-1.5169	0.9584	1.0250	1.0126	0.5646
12	2040.0393	29.9404	29.9453	29.9352	33.3090	29.9723	33.2789	33.2636	524.2669	524.5639	536.2886	536.2182	532.0979	539.5300	530.3278	531.1804	530.5721	1.3431	-1.3395	0.8890	1.0253	1.0120	0.5982
13	2002.9378	29.9549	29.9583	29.9502	33.4775	29.9754	33.4569	33.4363	524.1579	524.8206	536.1075	536.0372	532.6024	541.2544	530.1960	530.7286	529.7214	1.2817	-1.0674	0.7767	1.0231	1.0109	0.5984
14	2018.0821	29.9546	29.9579	29.9507	33.4710	29.9760	33.4333	33.4760	523.8977	523.5884	535.9335	535.8632	532.4319	540.1698	528.4013	529.1132	528.6544	0.4602	-0.3829	0.3204	1.0233	1.0095	0.6930
15	2005.8841	29.9630	29.9646	29.9630	33.6717	29.9701	33.6713	33.6764	522.7657	522.9837	535.6100	535.5397	532.9487	540.3139	527.0618	527.4925	526.9458	0.4470	-0.2817	0.2735	1.0120	1.0082	0.4172
16	2034.8228	29.9678	29.9687	29.9676	33.7911	29.9740	33.7343	33.7570	522.8993	523.2210	535.6013	535.5731	532.9470	540.8589	527.5417	527.9091	527.1813	1.1730	-0.7433	0.6907	1.0118	1.0086	0.3916
1	3033.7813	29.7857	29.8047	29.7703	39.3059	29.8846	39.2394	39.2165	533.9682	533.7520	538.9112	538.8743	530.2962	541.1102	546.2079	548.2452	548.3190	2.0315	-4.1914	1.2719	1.0613	1.0257	0.6671
2	3036.3914	29.7838	29.8022	29.7697	39.3071	29.8856	39.2592	39.2438	534.1071	533.9331	538.9341	538.8690	530.2382	540.6251	546.4048	548.2856	548.4421	1.7143	-3.5644	1.0848	1.0617	1.0256	0.6729
3	3021.0875	29.7822	29.7994	29.7699	39.1310	29.8796	39.0651	39.0683	534.3110	534.0596	538.7231	538.6897	530.2979	539.7391	546.5471	548.3454	548.4192	1.7042	-3.4392	1.0548	1.0605	1.0254	0.6656
4	3018.5339	29.7829	29.8017	29.7711	39.1791	29.8819	39.0865	39.0759	534.1704	533.8223	538.9112	538.8444	530.3665	540.8466	546.0550	548.1292	548.2698	2.1784	-4.4499	1.3746	1.0608	1.0253	0.6732
5	3018.8984	29.7884	29.8046	29.7760	38.6011	29.8784	38.5270	38.5391	534.2970	533.9419	539.2698	539.2206	531.0766	541.7009	546.1393	547.9675	547.8725	1.6800	-3.2936	1.0391	1.0600	1.0247	0.6793
6	3012.2148	29.7893	29.8067	29.7799	38.5874	29.8791	38.5331	38.5085	534.5114	534.2003	539.1977	539.1397	531.0503	541.1946	546.5436	548.2839	548.1309	1.8928	-3.6880	1.1557	1.0599	1.0249	0.6737
11	3022.7007	29.8889	29.9001	29.8790	33.6050	29.9599	33.5656	33.5524	524.1614	523.4389	537.2554	537.1798	529.4014	541.5163	534.5800	537.1675	537.2747	1.4467	-2.7138	0.9017	1.0585	1.0239	0.6840
12	3063.6633	29.8931	29.9096	29.8781	33.6174	29.9635	33.5948	33.6456	525.6766	526.3534	537.0022	536.9565	528.9866	539.8868	537.3854	540.1188	539.4948	1.0690	-2.0506	0.6580	1.0582	1.0247	0.6599
7	2995.3872	29.8193	29.8299	29.8107	36.7030	29.8816	36.6442	36.6658	534.5764	534.1721	538.8057	538.7319	531.9485	539.6108	545.6999	546.9901	545.8897	1.2776	-2.0912	0.7372	1.0546	1.0221	0.6920
8	3003.2888	29.8206	29.8297	29.8110	36.7068	29.8818	36.6544	36.6700	534.6345	534.1915	539.0483	538.9622	532.0962	540.8061	545.4432	546.9321	545.7087	1.2698	-2.1056	0.7553	1.0546	1.0217	0.7046
13	3010.8997	29.9158	29.9251	29.9081	33.4648	29.9602	33.4008	33.4254	525.3145	525.3690	536.8018	536.7772	530.1802	540.5513	534.8471	536.2182	535.6065	1.2545	-1.9900	0.8117	1.0535	1.0194	0.7711
14	3020.1141	29.9210	29.9302	29.9127	33.4571	29.9656	33.4164	33.4034	524.5938	524.5358	537.0655	536.9829	530.3454	541.5268	535.5485	536.9794	535.8596	1.4590	-2.3386	0.8426	1.0542	1.0220	0.6887
15	3012.3509	29.9493	29.9512	29.9487	33.2865	29.9609	33.2461	33.2343	523.8485	524.4954	536.3360	536.2833	531.8764	539.6600	532.2596	532.9874	531.9802	1.4372	-1.5292	0.7735	1.0275	1.0157	0.4952
16	3024.3920	29.9554	29.9586	29.9544	33.3017	29.9686	33.2820	33.2761	521.6759	523.0839	536.2868	536.2622	531.8852	540.2595	530.5792	531.4388	530.6987	1.0127	-1.0668	0.5214	1.0277	1.0163	0.4799
9	3011.6704	29.8691	29.8690	29.8660	33.2239	29.8704	33.1542	33.1771	534.9403	534.6995	538.9745	538.9323	535.1091	541.3264	544.7981	544.7911	543.6327	1.3595	-1.2543	0.5451	1.0172	1.0179	0.2720
10	3012.1845	29.8745	29.8750	29.8717	33.2152	29.8761	33.2043	33.1670	535.0686	534.9122	538.8708	538.8005	535.0071	540.8923	544.9194	544.9563	543.7364	1.3786	-1.2667	0.5529	1.0172	1.0178	0.2742
1	4022.8504	29.7089	29.7399	29.6867	42.6081	29.8777	42.4606	42.4955	534.1405	533.5253	539.1221	539.1643	525.0403	540.4897	555.1112	558.4511	558.9011	2.3721	-8.0289	1.4142	1.1113	1.0443	0.6910
2	4029.7130	29.7109	29.7424	29.6901	42.6437	29.8828	42.4885	42.5091	534.2706	533.7415	539.6354	539.5774	525.3796	541.8977	555.8073	558.8817	559.5936	2.5884	-8.8379	1.5287	1.1116	1.0451	0.6804
3	4015.7959	29.7129	29.7465	29.6923	42.5296	29.8807	42.3829	42.3781	534.3497	533.7872	539.8604	539.8182	525.7329	542.0718	555.4487	558.6479	559.3792	2.7401	-9.2769	1.6271	1.1111	1.0445	0.6869
4	4006.2771	29.7140	29.7462	29.6919	42.4866	29.8825	42.3645	42.3582	534.3971	533.7643	539.7673	539.7708	525.6854	541.5286	555.3169	558.6620	559.0083	2.5258	-8.5375	1.5085	1.1112	1.0442	0.6926
5	4014.2107	29.7244	29.7538	29.7073	41.8222	29.8800	41.6849	41.7156	534.5466	533.9788	539.5388	539.4895	526.1003	540.6462	555.3626	558.6497	558.5161	2.2875	-7.3642	1.3199	1.1087	1.0435	0.6874
6	4007.1869	29.7253	29.7552	29.7085	41.8574	29.8837	41.7010	41.6894	534.5466	534.0087	539.3208	539.2716	525.9122	540.2595	555.5577	558.7165	558.6163	2.8660	-9.2062	1.6426	1.1089	1.0437	0.6859
7	4013.7813	29.7695	29.7910	29.7546	39.5037	29.8840	39.3850	39.4078	534.8331	534.2161	539.5370	539.5247	527.8018	541.6569	554.4995	556.9798	555.2782	2.1084	-5.9352	1.1742	1.1009	1.0394	0.7063
8	4005.6618	29.7744	29.7927	29.7603	39.5073	29.8901	39.4014	39.4019	535.0071	534.3550	539.8077	539.7936	528.1376	542.2827	554.6471	556.9411	555.1516	2.2074	-6.1787	1.2319	1.1016	1.0391	0.7171
9	4006.0362	29.8684	29.8694	29.8661	35.8771	29.8740	35.8651	35.8647	535.5555	535.2005	539.6688	539.5405	533.6325	541.1278	552.2882	552.4288	550.5233	0.7364	-1.0556	0.2687	1.0315	1.0306	0.2908
10	4017.3823	29.8729	29.8738	29.8707	35.9184	29.8788	35.8500	35.8449	535.6944	535.3341	539.5300	539.4561	533.5815	540.7253	552.4798	552.5466	550.6991	1.7647	-2.5038	0.6363	1.0310	1.0306	0.2864
11	4044.7900	29.8299	29.8599	29.8034	36.0456	29.9554	35.9280	35.9409	526.2585	525.9333	537.8829	537.7950	524.8891	541.4776	546.4557	550.0311	548.8112	2.1033	-6.5369	1.2194	1.1065	1.0425	0.6908
12	4039.9693	29.8341	29.8605	29.8103	36.0714	29.9610	35.9348	35.9131	526.7225	526.8016	537.8917	537.7475	524.8276	541.2350	546.7669	550.1718	549.3667	2.5821	-8.0511	1.5244	1.1069	1.0418	0.7049
13	4029.9296	29.8748	29.8951	29.8561	34.6613	29.9566	34.5647	34.5553	525.1054	524.3899	537.5138	537.4136	526.4360	540.9432	543.5202	545.6805	543.9913	2.0769	-5.4967	1.1656	1.0985	1.0374	0.7264
14	4015.4197	29.8778	29.8996	29.8588	34.6643	29.9622	34.5856	34.5745	524.8083	524.2423	537.6825	537.5577	526.6575	541.8116	541.8028	544.5274	543.2055	1.9131	-5.0335	1.1243	1.0998	1.0356	0.7745
15	4030.3627	29.9332	29.9390	29.9305	33.9668	29.9565	33.9388	33.9309	523.6587	523.5497	536.8792	536.8915	530.2118	539.7690	537.4874	538.5245	537.1305	1.2078	-1.9345	0.5713	1.0507	1.0269	0.5284
16	4023.3629	29.9380	29.9418	29.9366	34.0112	29.9594	33.9281	33.9329	524.1843	524.2423	536.9108	536.8809	530.1608	540.3614	538.6423	539.7005	538.1343	1.7722	-2.8647	0.8168	1.0512	1.0279	0.5155
1	5022.4767	29.6271	29.6751	29.5985	40.8665	29.8933	40.6398	40.6108	534.4024	533.5921	540.0151	539.9290	519.2395	541.9241	567.5196	572.4520	572.7895	3.4815	-17.3235	1.9549	1.1751	1.0691	0.6825
2	5021.8460	29.6326	29.6785	29.6040	40.8519	29.9010	40.6292	40.6617	534.5343	533.6536	540.2876	540.1628	519.3011	542.2141	567.6567	572.4837	573.0866	3.0063	-15.0968	1.7009	1.1765	1.0692	0.6866
3	5020.9216	29.6285	29.6794	29.6025	40.8132	29.8957	40.5936	40.6084	534.5413	533.5657	540.2085	540.1417	519.5436	541.4899	567.2331	572.3747	572.7157	3.1185	-15.4412	1.7521	1.1747	1.0688	0.6846
4	5027.9479	29.6317	29.6804	29.6012	40.8387	29.8978	40.6468	40.6043	534.5026	533.2511	540.1698	540.0415	519.5384	541.1296	567.2735	571.9528	572.6911	3.3355	-16.4647	1.8661	1.1753	1.0689	0.6860
5	5018.7371	29.6455	29.6949	29.6208	41.0046	29.8944	40.7357	40.7803	534.7821	533.5921	539.8376	539.8077	519.9673	540.4862	566.6231	571.7595	571.1741	3.2719	-15.5916	1.8215	1.1727	1.0668	0.6975
6	5009.8954	29.6524	29.6945	29.6208	40.9512	29.8969	40.7469	40.7021	534.5888	533.6712	539.7268	539.6143	519.8231	540.3298	566.7145	571.6470	571.5573	3.4451	-16.4102	1.9077	1.1733	1.0671	0.6963
7	4993.3429	29.7131	29.7568	29.6879	38.3625	29.8926	38.1903	38.2091	535.0774	534.0526	539.9800	539.9220	522.4686	541.5919	564.7809	569.2300	565.8761	2.6207	-10.9958	1.4289	1.1592	1.0600	0.7188
8	4987.3660	29.7154	29.7613	29.6827	38.4023	29.8931	38.1880	38.1877	535.1600	533.9612	540.3895	540.3280	522.7534	542.3407	564.9936	569.2106	565.9376	3.0933	-13.0703	1.6937	1.1604	1.0601	0.7219
9	5010.3139	29.8654	29.8682	29.8636	39.7865	29.8766	39.7296	39.7144	536.6964	536.4520	540.0608	539.9870	531.5460	540.9696	563.2130	563.2745	560.2458	1.8375	-3.7388	0.6069	1.0475	1.0478	0.2790
10	5007.6372	29.8701	29.8721	29.8682	39.7499	29.8818	39.7202	39.7245	536.5557	536.1708	539.9993	539.9747	531.5214	540.7675	562.9159	562.8596	560.0630	1.1001	-2.2352	0.3640	1.0478	1.0477	0.2814
11	5034.4029	29.7500	29.7810	29.7198	39.1914	29.9429	38.9632	38.9710	526.3534	526.5028	537.9901	537.8952	518.7913	539.9694	558.5636	563.6893	562.4641	3.1734	-14.5858	1.7293	1.1706	1.0668	0.6896
12	5020.9216	29.7556	29.7855	29.7268	39.2010	29.9512	38.9923	38.9979	525.3602	524.9612	538.2802	538.1518	518.9688	541.0540	555.8477	561.6555	561.1475	3.0448	-14.0649	1.7041	1.1713	1.0655	0.7057
13	5008.3901	29.8204	29.8450	29.7893	37.3991	29.9475	37.2302	37.2403	526.0757	525.6766	538.0798	537.9936	521.5475	540.5442	555.3098	559.0663	555.2888	2.6354	-10.4295	1.4165	1.1605	1.0583	0.7447
14	5020.2072	29.8265	29.8499	29.8009	37.4044	29.9556	37.2326	37.2232	526.8069	526.6804	537.6913	537.6386	521.0694	539.5054	556.4911	560.3196	556.6475	2.8154	-11.2136	1.5035	1.1604	1.0590	0.7361
15	5025.3371	29.9168	29.9246	29.9110	33.8074	29.9512	33.7378	33.7487	525.2759	525.8050	537.4329	537.3626	527.8932	539.7602	546.5102	548.3999	545.8071	1.5349	-3.5013	0.6828	1.0811	1.0407	0.5539
16	5027.9899	29.9222	29.9297	29.9197	33.8210	29.9582	33.7340	33.7531	526.2444	526.7981	537.3221	537.2272	527.7157	539.7497	548.0413	550.1823	547.2766	1.6480	-3.7807	0.7167	1.0803	1.0417	0.5345
1	6021.8903	29.6251	29.6773	29.5721	45.4230	29.9450	45.1367	45.1628	524.3372	523.6903	538.0657	537.9655	509.0882	541.5655	569.7345	578.4848	578.3020	3.7027	-25.7063	2.0801	1.2685	1.0983	0.7156
2	6032.0606	29.6250	29.6730	29.5713	45.3892	29.9453	45.1706	45.1161	524.9595	524.7169	537.8108	537.6544	508.9352	540.3210	571.4307	579.4815	579.2249	3.7948	-26.2272	2.1066	1.2685	1.0988	0.7113
3	6063.9447	29.6208	29.6711	29.5656	45.0156	29.9383	44.7525	44.7315	525.6679	525.1528	538.5350	538.4278	509.4802	542.3882	572.4925	580.5591	580.5520	3.8471	-26.7770	2.1269	1.2685	1.0998	0.7041
4	6010.4288	29.6211	29.6688	29.5682	44.8632	29.9362	44.5688	44.5510	525.2161	524.4567	538.7530	538.6335	510.1218	542.4901	570.8524	579.5167	578.9753	4.0244	-27.5959	2.2278	1.2701	1.0983	0.7190
5	6038.7692	29.6314	29.6835	29.5792	44.6765	29.9307	44.3397	44.3584	524.9120	524.1034	538.9850	538.8479	511.0095	541.9487	569.6747	578.3108	577.4003	4.0551	-27.1596	2.2355	1.2633	1.0965	0.7156
6	6032.9706	29.6351	29.6841	29.5793	44.6726	29.9319	44.4151	44.3490	525.6731	525.4727	539.2927	539.1555	511.3346	542.1456	571.3745	579.7680	579.2671	4.0887	-27.3674	2.2258	1.2626	1.0975	0.7068
7	6055.0102	29.6234	29.6615	29.5743	43.3847	29.8875	43.0945	43.0914	526.0704	525.7399	538.9938	538.8497	511.8743	541.5163	570.9913	578.8346	577.2878	3.8400	-24.9271	2.0856	1.2588	1.0947	0.7177
8	6054.7962	29.6300	29.6749	29.5897	43.3861	29.8980	43.1020	43.0954	525.5044	524.7169	539.4561	539.2821	512.3173	542.5393	569.7485	577.7993	576.2243	3.8192	-24.7960	2.0880	1.2584	1.0942	0.7203
9	6028.1517	29.6945	29.7241	29.6566	41.8094	29.9070	41.5483	41.5520	525.8331	525.2548	538.6511	538.5438	513.5477	540.2718	569.2458	575.3348	571.7331	3.5382	-21.2717	1.9036	1.2435	1.0886	0.7251
10	6036.6733	29.7020	29.7334	29.6639	41.8290	29.9144	41.5608	41.5635	526.5626	526.2690	538.8110	538.7108	513.7376	541.4899	570.2723	576.5688	573.1341	3.5889	-21.5532	1.9144	1.2434	1.0891	0.7205
11	6024.5203	29.7496	29.7917	29.7038	40.3181	29.9201	40.1135	40.0689	525.6081	524.8874	539.0132	538.9270	516.1862	542.0190	567.6602	572.1497	568.0997	3.4138	-18.6669	1.7655	1.2323	1.0839	0.7332
12	6021.1347	29.7504	29.7781	29.7119	40.3391	29.9248	40.1106	40.0504	525.7593	524.8329	538.6247	538.4929	515.9718	540.6339	567.4563	571.5960	567.2454	3.6768	-19.9317	1.9105	1.2324	1.0828	0.7434
13	6053.3305	29.8778	29.8872	29.8756	39.5557	29.9271	39.4587	39.4432	528.0075	528.2343	538.3944	538.3663	524.8470	541.8872	560.4901	563.7702	559.6745	2.2824	-7.4134	0.9307	1.1194	1.0628	0.5212
14	6058.1589	29.8863	29.8976	29.8811	39.5584	29.9362	39.4692	39.4548	526.5327	527.0003	538.4876	538.3962	524.9032	541.8362	557.7831	560.9929	557.5809	2.1905	-7.1177	0.9262	1.1195	1.0608	0.5394
15	6023.7340	29.9257	29.9288	29.9224	38.4195	29.9376	38.3388	38.3209	526.3780	525.7487	537.7388	537.6720	525.8964	539.7884	564.7071	564.7194	560.7520	2.1119	-5.9854	0.6681	1.0689	1.0710	0.2710
16	6029.9694	29.9317	29.9345	29.9279	38.4161	29.9441	38.3404	38.3569	526.8298	526.4993	537.8548	537.7915	526.0089	540.6233	565.3065	565.4524	561.4798	1.6400	-4.6502	0.5179	1.0691	1.0710	0.2712

Run #	RPM	CFF Corrected Mass Flow (lbm/s)	Corrected Power (HP)	Corrected Speed (RPM)	X1	mdot1	X2	mdot2	X3	mdot3	Computed MA Mdot	Computed MA Power (hp)	Corrected Computed MA Mdot(kg/s)	Corrected Computed MA HP	Ttbar Out	Ptbar Out	Pt_bar	Tt_bar	Mach Exit	Temp Exit	Velocity Exit (m/s)	Corrected Thrust (lbf/ 12inch span)	M_dot_Inlet	Corrected Computed MA Mdot(lbm/s)
1	2029.3788	0.9859	2.0038	2004.4287	0.0870	0.2991	0.0902	0.1773	0.0891	0.3065	0.7829	1.9625	0.7954	1.9414	538.7997	30.6199	30.6199	538.7997	0.1988	530.4144	68.4517	53.0300	0.9385	0.9535
2	2031.1444	1.0119	2.0624	2005.7623	0.0875	0.3008	0.0905	0.1779	0.0893	0.3071	0.7858	1.9705	0.7985	1.9489	539.0420	30.6258	30.6258	539.0420	0.1996	530.5897	68.7246	53.2462	0.9383	0.9535
3	2024.6127	0.9726	1.9688	1998.7157	0.0861	0.2959	0.0891	0.1750	0.0887	0.3051	0.7760	2.0354	0.7888	2.0125	539.3255	30.6110	30.6110	539.3255	0.1971	531.0699	67.9203	54.6680	0.9745	0.9906
4	2023.8887	0.8934	1.8150	1997.9088	0.0867	0.2980	0.0895	0.1759	0.0882	0.3033	0.7771	2.0489	0.7900	2.0258	539.4006	30.6130	30.6130	539.4006	0.1974	531.1220	68.0152	54.8732	0.9768	0.9929
5	2017.2069	0.8715	1.7255	1990.9961	0.0819	0.2818	0.0853	0.1678	0.0848	0.2921	0.7417	1.9712	0.7541	1.9485	539.4060	30.6110	30.6110	539.4060	0.1881	531.8805	64.8472	51.7314	0.9657	0.9817
6	2028.0412	0.9846	1.9953	2001.4786	0.0817	0.2813	0.0854	0.1681	0.0847	0.2916	0.7409	1.9832	0.7533	1.9600	539.6603	30.6116	30.6116	539.6603	0.1879	532.1438	64.8088	50.8022	0.9488	0.9646
7	2039.0132	0.6775	1.2495	2012.1561	0.0659	0.2283	0.0708	0.1401	0.0667	0.2311	0.5995	1.6075	0.6092	1.5877	539.1876	30.5820	30.5820	539.1876	0.1511	534.3079	52.2184	36.5190	0.8464	0.8601
8	2050.2728	0.9650	1.7227	2023.5674	0.0662	0.2293	0.0704	0.1394	0.0676	0.2343	0.6029	1.5755	0.6126	1.5564	538.8533	30.5872	30.5872	538.8533	0.1518	533.9291	52.4561	37.1374	0.8570	0.8708
9	2022.0812	0.3071	0.4715	1994.5736	0.0220	0.0758	0.0215	0.0422	0.0204	0.0702	0.1882	0.9881	0.1912	0.9747	538.7246	30.0907	30.0907	538.7246	0.0476	538.2364	16.5170	8.5464	0.6260	0.6359
10	2039.4846	0.0944	0.1491	2011.8709	0.0201	0.0692	0.0216	0.0425	0.0195	0.0673	0.1790	0.9119	0.1818	0.8995	538.8012	30.0930	30.0930	538.8012	0.0453	538.3590	15.7184	7.2751	0.5600	0.5687
11	2025.8842	0.9629	2.1323	2015.4909	0.0739	0.2576	0.0776	0.1546	0.0763	0.2663	0.6785	2.2225	0.6824	2.2080	531.5946	30.6787	30.6787	531.5946	0.1698	525.5359	58.1857	47.7491	1.0013	1.0070
12	2040.0393	0.8927	1.8842	2030.8469	0.0745	0.2601	0.0783	0.1563	0.0760	0.2656	0.6820	2.0450	0.6854	2.0329	530.6164	30.6851	30.6851	530.6164	0.1705	524.5201	58.3657	46.3461	0.9695	0.9744
13	2002.9378	0.7795	1.5005	1993.7721	0.0571	0.2002	0.0641	0.1285	0.0588	0.2062	0.5349	1.6282	0.5374	1.6177	530.1463	30.6310	30.6310	530.1463	0.1333	526.4039	45.7299	31.7074	0.8465	0.8504
14	2018.0821	0.3213	0.5387	2010.2777	0.0571	0.2004	0.0644	0.1292	0.0593	0.2082	0.5378	1.4175	0.5399	1.4094	528.6666	30.6361	30.6361	528.6666	0.1339	524.9039	45.8539	31.8008	0.8473	0.8506
15	2005.8841	0.2740	0.3965	1999.7853	0.0347	0.1213	0.0402	0.0805	0.0363	0.1270	0.3288	1.0925	0.3296	1.0866	527.1244	30.3204	30.3204	527.1244	0.0822	525.7049	28.1639	17.4506	0.7576	0.7596
16	2034.8228	0.6919	1.0458	2028.2764	0.0341	0.1194	0.0393	0.0785	0.0359	0.1254	0.3233	1.0684	0.3242	1.0624	527.4977	30.3136	30.3136	527.4977	0.0808	526.1244	27.7022	16.0745	0.7094	0.7113
1	3033.7813	1.2950	5.8726	2993.2768	0.1330	0.4560	0.1362	0.2671	0.1338	0.4598	1.1829	6.2693	1.2055	6.2080	547.4818	31.6014	31.6014	547.4818	0.3025	528.1528	103.9274	114.5945	1.3343	1.3598
2	3036.3914	1.1048	4.9938	2995.4033	0.1329	0.4554	0.1370	0.2688	0.1341	0.4606	1.1848	6.3048	1.2077	6.2426	547.6145	31.6075	31.6075	547.6145	0.3030	528.2130	104.1223	115.6820	1.3442	1.3703
3	3021.0875	1.0743	4.8173	2979.8450	0.1314	0.4507	0.1353	0.2654	0.1320	0.4534	1.1695	6.2948	1.1923	6.2314	547.6767	31.5739	31.5739	547.6767	0.2990	528.7633	102.8040	114.9160	1.3522	1.3786
4	3018.5339	1.3998	6.2341	2977.8531	0.1318	0.4521	0.1353	0.2654	0.1324	0.4551	1.1726	6.2051	1.1952	6.1437	547.3784	31.5837	31.5837	547.3784	0.2997	528.3937	102.9975	114.4186	1.3441	1.3700
5	3018.8984	1.0579	4.6121	2977.8696	0.1241	0.4273	0.1289	0.2539	0.1268	0.4376	1.1188	5.9527	1.1401	5.8912	547.2162	31.5715	31.5715	547.2162	0.2846	530.0448	97.9553	106.6990	1.3178	1.3429
6	3012.2148	1.1769	5.1634	2970.6194	0.1241	0.4272	0.1286	0.2532	0.1267	0.4372	1.1176	5.9337	1.1392	5.8712	547.5446	31.5685	31.5685	547.5446	0.2844	530.3883	97.9123	105.5695	1.3041	1.3293
11	3022.7007	0.9063	3.8257	3010.8470	0.1121	0.3931	0.1198	0.2405	0.1129	0.3970	1.0306	5.5780	1.0369	5.5574	536.2117	31.6132	31.6132	536.2117	0.2571	522.3992	87.8539	94.9120	1.3198	1.3278
12	3063.6633	0.6627	2.8844	3045.2175	0.1120	0.3920	0.1189	0.2381	0.1128	0.3959	1.0260	5.6566	1.0344	5.6234	538.8257	31.6082	31.6082	538.8257	0.2565	525.0091	87.8671	93.2707	1.2940	1.3046
7	2995.3872	0.7499	2.9245	2953.9732	0.0969	0.3377	0.1075	0.2144	0.0978	0.3412	0.8933	4.5279	0.9096	4.4751	546.0813	31.4332	31.4332	546.0813	0.2245	535.2933	77.6419	72.0463	1.1223	1.1427
8	3003.2888	0.7684	2.9444	2961.6584	0.0969	0.3379	0.1069	0.2133	0.0986	0.3441	0.8953	4.4304	0.9116	4.3784	545.8982	31.4363	31.4363	545.8982	0.2248	535.0802	77.7497	71.9563	1.1193	1.1397
13	3010.8997	0.8162	2.7984	2994.6886	0.0876	0.3106	0.0968	0.1963	0.0876	0.3106	0.8175	3.9576	0.8229	3.9332	535.4649	31.4970	31.4970	535.4649	0.2018	526.8783	69.2688	65.1647	1.1476	1.1551
14	3020.1141	0.8467	3.2910	3006.0772	0.0883	0.3131	0.0972	0.1971	0.0877	0.3110	0.8213	4.3365	0.8260	4.3128	536.0106	31.5185	31.5185	536.0106	0.2028	527.3376	69.6161	63.4710	1.1130	1.1194
15	3012.3509	0.7760	2.1499	2999.4735	0.0521	0.1834	0.0591	0.1189	0.0528	0.1860	0.4883	2.4667	0.4903	2.4509	532.3319	30.7711	30.7711	532.3319	0.1213	529.2174	41.7173	30.3856	0.8895	0.8931
16	3024.3920	0.5221	1.5024	3016.6243	0.0528	0.1861	0.0601	0.1210	0.0540	0.1903	0.4974	2.3823	0.4986	2.3711	530.8330	30.7773	30.7773	530.8330	0.1234	527.6193	42.3770	28.7769	0.8307	0.8327
9	3011.6704	0.5537	1.7500	2968.7937	0.0350	0.1208	0.0360	0.0711	0.0328	0.1131	0.3050	2.3227	0.3101	2.2902	544.3348	30.3962	30.3962	544.3348	0.0770	543.0467	26.8284	15.7436	0.7095	0.7213
10	3012.1845	0.5616	1.7668	2968.8273	0.0342	0.1184	0.0362	0.0714	0.0324	0.1118	0.3017	2.0954	0.3067	2.0655	544.4639	30.4000	30.4000	544.4639	0.0762	543.2025	26.5496	14.1174	0.6428	0.6535
1	4022.8504	1.4440	11.2817	3969.2420	0.1756	0.6014	0.1806	0.3543	0.1754	0.6028	1.5586	13.9902	1.5929	13.8930	557.3329	32.9824	32.9824	557.3329	0.4013	523.5965	137.3014	195.2728	1.7210	1.7589
2	4029.7130	1.5611	12.4162	3975.3685	0.1759	0.6024	0.1813	0.3558	0.1747	0.6001	1.5583	14.1704	1.5929	14.0696	557.9729	32.9875	32.9875	557.9729	0.4015	524.1712	137.4341	194.1254	1.7090	1.7469
3	4015.7959	1.6615	13.0312	3961.4076	0.1747	0.5986	0.1801	0.3535	0.1744	0.5995	1.5517	13.8641	1.5861	13.7636	557.6941	32.9763	32.9763	557.6941	0.3994	524.2383	136.7290	191.6981	1.6962	1.7338
4	4006.2771	1.5402	11.9905	3951.9722	0.1746	0.5986	0.1803	0.3539	0.1747	0.6008	1.5533	13.7364	1.5875	13.6344	557.5016	32.9846	32.9846	557.5016	0.3997	524.0087	136.8050	191.7319	1.6956	1.7329
5	4014.2107	1.3474	10.3371	3959.1240	0.1656	0.5712	0.1717	0.3391	0.1656	0.5730	1.4833	13.1078	1.5157	13.0034	557.3284	32.9214	32.9214	557.3284	0.3788	527.0725	130.0260	176.6334	1.6432	1.6790
6	4007.1869	1.6769	12.9229	3952.1413	0.1656	0.5713	0.1713	0.3383	0.1661	0.5747	1.4844	13.1254	1.5168	13.0211	557.4549	32.9308	32.9308	557.4549	0.3790	527.1604	130.1092	176.1276	1.6374	1.6732
7	4013.7813	1.1969	8.3148	3957.7305	0.1335	0.4710	0.1426	0.2878	0.1295	0.4568	1.2156	10.2381	1.2403	10.1367	555.3884	32.7373	32.7373	555.3884	0.3029	535.7279	104.8149	123.1621	1.4210	1.4498
8	4005.6618	1.2557	8.6538	3949.1466	0.1339	0.4726	0.1422	0.2871	0.1315	0.4643	1.2240	9.9953	1.2489	9.8938	555.3800	32.7665	32.7665	555.3800	0.3047	535.4937	105.4149	121.9051	1.3983	1.4267
9	4006.0362	0.2731	1.4720	3946.9440	0.0458	0.1593	0.0464	0.0920	0.0431	0.1494	0.4007	3.9726	0.4076	3.9154	551.6190	30.8194	30.8194	551.6190	0.1006	549.3935	35.2643	20.7331	0.7104	0.7227
10	4017.3823	0.6468	3.4910	3957.6192	0.0433	0.1506	0.0454	0.0899	0.0415	0.1439	0.3844	3.6902	0.3911	3.6363	551.7980	30.8076	30.8076	551.7980	0.0966	549.7477	33.8482	18.4383	0.6581	0.6696
11	4044.7900	1.2309	9.2144	4020.1281	0.1516	0.5352	0.1579	0.3189	0.1478	0.5222	1.3763	11.1785	1.3907	11.1362	548.2001	32.9672	32.9672	548.2001	0.3431	523.5419	117.3833	142.4011	1.4788	1.4942
12	4039.9693	1.5399	11.3428	4012.7968	0.1523	0.5377	0.1580	0.3190	0.1472	0.5200	1.3767	10.8814	1.3921	10.8345	548.5713	32.9781	32.9781	548.5713	0.3433	523.8713	117.4826	140.5981	1.4579	1.4742
13	4029.9296	1.1733	7.7463	4010.5004	0.1205	0.4340	0.1292	0.2660	0.1168	0.4202	1.1202	8.1043	1.1287	8.0717	544.2156	32.7804	32.7804	544.2156	0.2732	528.4384	93.8947	93.9066	1.2207	1.2299
14	4015.4197	1.1315	7.0949	3996.9074	0.1217	0.4386	0.1306	0.2693	0.1173	0.4228	1.1307	7.5476	1.1390	7.5187	542.9958	32.8176	32.8176	542.9958	0.2754	527.0028	94.5346	92.8081	1.1985	1.2073
15	4030.3627	0.5730	2.7224	4015.3087	0.0716	0.2549	0.0802	0.1631	0.0699	0.2487	0.6667	3.5702	0.6693	3.5509	537.6047	31.4466	31.4466	537.6047	0.1641	531.8730	56.5934	34.7584	0.7504	0.7534
16	4023.3629	0.8197	4.0288	4006.0057	0.0723	0.2570	0.0808	0.1642	0.0712	0.2531	0.6743	3.4534	0.6774	3.4325	538.7063	31.4629	31.4629	538.7063	0.1661	532.8277	57.3142	32.8946	0.7009	0.7040
1	5022.4767	2.0028	24.4163	4954.7846	0.2141	0.7334	0.2206	0.4330	0.2146	0.7384	1.9048	26.0651	1.9533	25.9634	570.6699	34.7523	34.7523	570.6699	0.4942	519.8837	168.4606	285.1227	2.0478	2.1000
2	5021.8460	1.7428	21.2762	4953.7140	0.2141	0.7330	0.2215	0.4350	0.2159	0.7432	1.9112	25.8822	1.9600	25.7790	570.8377	34.7917	34.7917	570.8377	0.4958	519.7263	168.9992	283.4758	2.0293	2.0812
3	5020.9216	1.7949	21.7600	4952.9896	0.2126	0.7286	0.2192	0.4307	0.2146	0.7395	1.8987	25.7474	1.9470	25.6430	570.5031	34.7460	34.7460	570.5031	0.4920	520.1338	167.7677	282.2342	2.0353	2.0871
4	5027.9479	1.9114	23.2057	4960.7414	0.2130	0.7300	0.2198	0.4321	0.2146	0.7395	1.9016	25.7600	1.9496	25.6592	570.4165	34.7637	34.7637	570.4165	0.4927	519.9342	167.9557	281.9975	2.0317	2.0829
5	5018.7371	1.8652	21.9561	4950.2156	0.2031	0.7035	0.2102	0.4170	0.2050	0.7134	1.8339	24.1437	1.8796	24.0284	569.5369	34.7069	34.7069	569.5369	0.4695	523.3848	160.5909	261.3721	1.9689	2.0180
6	5009.8954	1.9531	23.1089	4941.7588	0.2035	0.7045	0.2107	0.4183	0.2051	0.7137	1.8365	24.1812	1.8821	24.0658	569.6958	34.7249	34.7249	569.6958	0.4702	523.4101	160.8232	260.5777	1.9601	2.0088
7	4993.3429	1.4597	15.4370	4923.4267	0.1610	0.5772	0.1773	0.3643	0.1575	0.5646	1.5060	18.5134	1.5400	18.3688	566.2768	34.3657	34.3657	566.2768	0.3715	536.6572	128.6517	179.4622	1.6869	1.7249
8	4987.3660	1.7303	18.3503	4917.5537	0.1604	0.5749	0.1776	0.3649	0.1602	0.5747	1.5145	18.5402	1.5487	18.3963	566.3679	34.4005	34.4005	566.3679	0.3733	536.4632	129.2693	180.0345	1.6842	1.7222
9	5010.3139	0.6175	5.2090	4930.9023	0.0514	0.1795	0.0537	0.1069	0.0504	0.1754	0.4618	6.4585	0.4703	6.3594	562.0738	31.2916	31.2916	562.0738	0.1154	559.0937	40.8076	24.8387	0.7347	0.7483
10	5007.6372	0.3704	3.1146	4929.2370	0.0508	0.1776	0.0546	0.1087	0.0505	0.1761	0.4624	6.0131	0.4708	5.9217	561.8070	31.3002	31.3002	561.8070	0.1156	558.8200	40.8550	23.2046	0.6857	0.6983
11	5034.4029	1.7515	20.6164	5002.1280	0.1861	0.6622	0.1965	0.4007	0.1845	0.6584	1.7213	22.2251	1.7451	22.2016	561.2573	34.7499	34.7499	561.2573	0.4280	522.9418	146.3230	223.3020	1.8597	1.8854
12	5020.9216	1.7238	19.9025	4994.7491	0.1866	0.6649	0.1967	0.4021	0.1848	0.6613	1.7283	21.4335	1.7500	21.4349	559.2380	34.7735	34.7735	559.2380	0.4288	520.9212	146.3255	220.1206	1.8353	1.8583
13	5008.3901	1.4302	14.7110	4978.8927	0.1478	0.5433	0.1645	0.3462	0.1441	0.5290	1.4185	16.0406	1.4336	15.9904	556.2185	34.5297	34.5297	556.2185	0.3410	531.4920	117.5458	149.0006	1.5455	1.5620
14	5020.2072	1.5194	15.8045	4986.5290	0.1481	0.5435	0.1647	0.3462	0.1440	0.5281	1.4178	15.8579	1.4341	15.7957	557.4859	34.5259	34.5259	557.4859	0.3414	532.6564	117.7902	145.6850	1.5067	1.5241
15	5025.3371	0.6866	4.9212	4997.3354	0.0879	0.3162	0.1010	0.2078	0.0895	0.3219	0.8459	6.5577	0.8514	6.5141	546.7115	32.3258	32.3258	546.7115	0.2063	537.5598	71.5118	53.3169	0.9093	0.9152
16	5027.9899	0.7213	5.3086	4995.3140	0.0863	0.3102	0.1005	0.2063	0.0901	0.3235	0.8400	6.3232	0.8462	6.2748	548.2848	32.3060	32.3060	548.2848	0.2053	539.1934	71.2755	49.8497	0.8522	0.8584
1	6021.8903	2.1129	36.6081	5997.0525	0.2514	0.8844	0.2599	0.5248	0.2454	0.8669	2.2761	40.9637	2.3143	41.2281	575.0811	37.4367	37.4367	575.0811	0.5803	506.8132	195.3141	372.7449	2.3309	2.3700
2	6032.0606	2.1415	37.3194	6002.4611	0.2513	0.8833	0.2599	0.5242	0.2457	0.8667	2.2742	41.4251	2.3140	41.6583	576.3137	37.4366	37.4366	576.3137	0.5805	507.8669	195.5699	374.4561	2.3367	2.3777
3	6063.9447	2.1634	38.0835	6030.9022	0.2507	0.8806	0.2596	0.5236	0.2447	0.8630	2.2673	42.1708	2.3084	42.3881	577.4858	37.4306	37.4306	577.4858	0.5788	509.2439	195.2769	376.2163	2.3500	2.3926
4	6010.4288	2.2647	39.2665	5980.9454	0.2507	0.8819	0.2602	0.5256	0.2461	0.8697	2.2773	41.3934	2.3172	41.6261	575.9980	37.4820	37.4820	575.9980	0.5804	507.6081	195.4886	376.3144	2.3493	2.3905
5	6038.7692	2.2697	38.6220	6011.0295	0.2387	0.8500	0.2501	0.5116	0.2328	0.8324	2.1940	39.8411	2.2296	40.0405	574.6815	37.3061	37.3061	574.6815	0.5510	512.4521	186.4761	352.6317	2.3086	2.3461
6	6032.9706	2.2618	38.8716	5999.1687	0.2387	0.8488	0.2494	0.5096	0.2325	0.8299	2.1883	40.3008	2.2257	40.4548	576.3906	37.2948	37.2948	576.3906	0.5503	514.1207	186.5368	352.3540	2.3037	2.3431
7	6055.0102	2.1183	35.3662	6019.1827	0.2235	0.8089	0.2345	0.4870	0.2182	0.7920	2.0880	39.8760	2.1227	39.9839	575.2601	37.2176	37.2176	575.2601	0.5144	520.2086	175.3921	337.7937	2.3481	2.3871
8	6054.7962	2.1188	35.2017	6023.5218	0.2238	0.8113	0.2348	0.4881	0.2168	0.7878	2.0872	38.9105	2.1200	39.0396	574.1485	37.2099	37.2099	574.1485	0.5137	519.3271	175.0250	331.1000	2.3081	2.3444
9	6028.1517	1.9292	30.1355	5994.5422	0.1929	0.7174	0.2096	0.4470	0.1842	0.6839	1.8482	33.1532	1.8749	33.1940	571.6837	36.8179	36.8179	571.6837	0.4423	530.1916	152.2679	261.2818	2.0928	2.1230
10	6036.6733	1.9414	30.5023	5998.0430	0.1926	0.7155	0.2090	0.4454	0.1847	0.6857	1.8466	32.9358	1.8744	32.9416	572.8998	36.8238	36.8238	572.8998	0.4421	531.3534	152.3675	257.8719	2.0624	2.0934
11	6024.5203	1.7855	26.4044	5992.6200	0.1682	0.6354	0.1885	0.4083	0.1655	0.6246	1.6683	27.9502	1.6889	27.9412	568.9264	36.5615	36.5615	568.9264	0.3916	536.0468	135.5466	207.5145	1.8677	1.8906
12	6021.1347	1.9324	28.1943	5988.9767	0.1677	0.6336	0.1877	0.4068	0.1669	0.6302	1.6706	27.6744	1.6913	27.6664	568.3844	36.5647	36.5647	568.3844	0.3917	535.5205	135.5144	208.2169	1.8744	1.8976
13	6053.3305	0.9387	10.4019	6004.8764	0.1017	0.3708	0.1207	0.2517	0.1025	0.3737	0.9962	13.3646	1.0058	13.2528	561.0152	33.4331	33.4331	561.0152	0.2410	548.2787	84.3624	82.4428	1.1889	1.2004
14	6058.1589	0.9330	9.9991	6017.3871	0.1029	0.3763	0.1197	0.2504	0.1005	0.3673	0.9940	12.2838	1.0023	12.1958	558.5150	33.4403	33.4403	558.5150	0.2397	545.9660	83.7395	77.9359	1.1338	1.1431
15	6023.7340	0.6717	8.4033	5987.1910	0.0534	0.1902	0.0548	0.1114	0.0577	0.2051	0.5067	10.5808	0.5099	10.4986	563.2249	32.0085	32.0085	563.2249	0.1242	559.7692	43.9428	30.1347	0.8360	0.8412
16	6029.9694	0.5209	6.5246	5989.9670	0.0537	0.1913	0.0564	0.1144	0.0584	0.2076	0.5132	9.8967	0.5167	9.8137	563.9128	32.0127	32.0127	563.9128	0.1260	560.3571	44.5748	28.5267	0.7797	0.7850

A3. TEST 2: TWO CAVITIES BLANKED

Run #	RPM	Patm	Pcal	Pin TTR (5 o/c)	Pout TTR	Pin TTR (8 o/c)	Pin CFF (2 o/c)	Pin CFF (10 o/c)	Pout CFF (Top)	Pout CFF (Mid)	Pout CFF (Bot)	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
1	2037.5868	29.80	39.80	30.1766	29.9698	31.0637	29.7965	29.7461	30.3880	30.4189	30.4588	29.7164	29.4059	29.4001	29.4035	29.4373	29.7151	29.7787	29.8470	29.9327	29.8031	29.7979	29.7893
2	2035.0298	29.80	39.80	30.1896	29.9703	31.0695	29.7939	29.7466	30.4020	30.4318	30.4696	29.7151	29.4053	29.3986	29.4020	29.4356	29.7146	29.7795	29.8497	29.9417	29.8061	29.7991	29.7900
3	2016.5357	29.80	39.80	30.2049	29.9652	31.0448	29.7896	29.7475	30.3871	30.4160	30.4552	29.7218	29.4065	29.4023	29.4038	29.4372	29.7127	29.7776	29.8465	29.9512	29.8042	29.7954	29.7864
4	2027.5409	29.80	39.80	30.2154	29.9659	31.0445	29.7903	29.7454	30.3909	30.4214	30.4620	29.7209	29.4132	29.4046	29.4038	29.4372	29.7139	29.7789	29.8478	29.9515	29.8046	29.7959	29.7869
5	2025.6448	29.80	39.80	30.2265	29.9506	30.9639	29.7891	29.7505	30.3567	30.3986	30.4304	29.7787	29.4604	29.4566	29.4602	29.4947	29.7247	29.7877	29.8483	29.9561	29.8163	29.7921	29.7831
6	2027.7396	29.80	39.80	30.2355	29.9507	30.9619	29.7908	29.7516	30.3581	30.3959	30.4431	29.7799	29.4581	29.4558	29.4572	29.4900	29.7221	29.7894	29.8494	29.9611	29.8200	29.7931	29.7839
7	2038.8747	29.80	39.80	30.2505	29.9366	30.8756	29.7913	29.7570	30.3269	30.3835	30.3942	29.8484	29.5197	29.5215	29.5247	29.5672	29.7323	29.8006	29.8555	29.9724	29.8381	29.7883	29.7799
8	2030.9244	29.80	39.80	30.2598	29.9371	30.8766	29.7934	29.7590	30.3354	30.3855	30.4101	29.8497	29.5206	29.5228	29.5264	29.5693	29.7349	29.8027	29.8582	29.9717	29.8370	29.7912	29.7821
9	2059.5485	29.80	39.80	30.2730	29.9193	30.7388	29.7956	29.7686	30.2690	30.3520	30.3305	29.9363	29.5978	29.6106	29.6171	29.6586	29.7500	29.8115	29.8600	29.9740	29.8512	29.7879	29.7800
10	2021.0460	29.80	39.80	30.2793	29.9179	30.7350	29.7969	29.7688	30.2803	30.3590	30.3367	29.9382	29.5971	29.6110	29.6185	29.6594	29.7512	29.8115	29.8591	29.9723	29.8520	29.7895	29.7812
11	2039.8937	29.80	39.80	30.2910	29.8993	30.6344	29.7978	29.7748	30.2384	30.3092	30.2728	29.9785	29.6327	29.6480	29.6517	29.6789	29.7626	29.8034	29.8509	29.9568	29.8471	29.7870	29.7796
12	2046.7967	29.80	39.80	30.2987	29.8989	30.6327	29.8000	29.7767	30.2279	30.2991	30.2626	29.9754	29.6382	29.6536	29.6566	29.6840	29.7651	29.8051	29.8522	29.9561	29.8482	29.7897	29.7824
13	2049.6075	29.80	39.80	30.3038	29.8765	30.5178	29.7994	29.7840	30.1443	30.2086	30.2032	30.0146	29.6703	29.6974	29.7012	29.7190	29.7752	29.8044	29.8447	29.9420	29.8343	29.7872	29.7813
14	2033.5813	29.80	39.80	30.3111	29.8775	30.5229	29.8016	29.7845	30.1543	30.2200	30.2280	30.0239	29.6675	29.6968	29.7005	29.7190	29.7772	29.8080	29.8497	29.9480	29.8375	29.7903	29.7839
15	2078.2173	29.80	39.80	30.3148	29.8672	30.4538	29.8009	29.7887	30.0897	30.1261	30.1041	30.0172	29.6636	29.7168	29.7290	29.7435	29.7819	29.7870	29.8236	29.9018	29.8066	29.7864	29.7822
16	2058.0510	29.80	39.80	30.3201	29.8674	30.4538	29.8023	29.7901	30.0892	30.1264	30.1098	30.0165	29.6663	29.7194	29.7315	29.7470	29.7842	29.7893	29.8248	29.9025	29.8078	29.7887	29.7849
1	3059.8200	29.80	39.80	30.3434	30.1435	32.3678	29.7290	29.6790	31.2265	31.2936	31.3294	29.6160	28.9169	28.8767	28.8695	28.9316	29.6078	29.7610	29.9480	30.1359	29.8033	29.8004	29.7816
2	3066.4974	29.80	39.80	30.3552	30.1469	32.3729	29.7307	29.6817	31.2266	31.3079	31.3360	29.6176	28.9186	28.8763	28.8734	28.9348	29.6083	29.7658	29.9533	30.1414	29.8088	29.8043	29.7856
3	3054.0727	29.80	39.80	30.3686	30.1586	32.3489	29.7308	29.6826	31.2227	31.3159	31.3209	29.6312	28.9319	28.8914	28.8932	28.9487	29.6106	29.7686	29.9489	30.1399	29.8115	29.8037	29.7844
4	3051.4630	29.80	39.80	30.3773	30.1589	32.3576	29.7323	29.6845	31.2260	31.2940	31.3359	29.6322	28.9357	28.8936	28.8872	28.9523	29.6114	29.7710	29.9516	30.1421	29.8121	29.8060	29.7865
5	3059.3829	29.80	39.80	30.3864	30.1559	32.1834	29.7373	29.6946	31.1672	31.2544	31.2920	29.7646	29.0307	29.0000	28.9973	29.0571	29.6311	29.8014	29.9742	30.1717	29.8533	29.8015	29.7832
6	3059.7105	29.80	39.80	30.3941	30.1635	32.2082	29.7368	29.6937	31.1656	31.2549	31.3090	29.7649	29.0276	28.9954	28.9995	29.0558	29.6307	29.8029	29.9757	30.1730	29.8530	29.8034	29.7841
7	3051.6027	29.80	39.80	30.4102	30.1290	32.0043	29.7432	29.7065	31.1174	31.2228	31.2218	29.9112	29.1801	29.1442	29.1363	29.2051	29.6549	29.8319	29.9851	30.1950	29.9019	29.8001	29.7832
8	3066.4504	29.80	39.80	30.4192	30.1310	32.0107	29.7453	29.7093	31.1304	31.2341	31.2349	29.9127	29.1822	29.1451	29.1374	29.2020	29.6587	29.8372	29.9916	30.2025	29.9060	29.8053	29.7877
9	3066.2310	29.80	39.80	30.4278	30.0475	31.6508	29.7592	29.7346	30.9566	31.1389	31.0454	30.1291	29.3723	29.3667	29.3788	29.4574	29.7024	29.8735	30.0041	30.2134	29.9510	29.8013	29.7858
10	3062.1466	29.80	39.80	30.4339	30.0470	31.6421	29.7611	29.7350	30.9750	31.1478	31.0403	30.1326	29.3724	29.3696	29.3784	29.4565	29.7041	29.8731	30.0056	30.2141	29.9528	29.8036	29.7883
11	3066.4504	29.80	39.80	30.4401	29.9853	31.3846	29.7688	29.7535	30.8295	31.0337	30.8863	30.2427	29.4605	29.4797	29.4883	29.5455	29.7366	29.8577	29.9823	30.1701	29.9431	29.7989	29.7860
12	3059.5234	29.80	39.80	30.4450	29.9863	31.3797	29.7697	29.7540	30.8325	31.0333	30.8844	30.2446	29.4621	29.4821	29.4888	29.5470	29.7383	29.8589	29.9830	30.1827	29.9488	29.8010	29.7877
13	3063.0845	29.80	39.80	30.4480	29.9352	31.0835	29.7810	29.7739	30.6293	30.7762	30.7499	30.3286	29.5180	29.5809	29.5925	29.6343	29.7652	29.8528	29.9564	30.1430	29.9131	29.7887	29.7856
14	3053.4355	29.80	39.80	30.4492	29.9331	31.0841	29.7814	29.7744	30.6207	30.7706	30.7444	30.3279	29.5199	29.5829	29.5933	29.6352	29.7644	29.8550	29.9548	30.1386	29.9105	29.7894	29.7862
15	3055.1924	29.80	39.80	30.4536	29.9030	30.8732	29.7879	29.7851	30.4708	30.5254	30.4665	30.2995	29.5007	29.6244	29.6580	29.6928	29.7778	29.7944	29.8842	30.0245	29.8336	29.7847	29.7845
16	3059.3986	29.80	39.80	30.4537	29.9034	30.8746	29.7893	29.7864	30.4780	30.5301	30.4721	30.3049	29.5042	29.6274	29.6606	29.6949	29.7816	29.7997	29.8905	30.0307	29.8384	29.7874	29.7875
1	4075.7552	29.75	39.75	30.4436	30.4709	34.2423	29.6332	29.5455	32.4558	32.5840	32.5740	29.4554	28.2169	28.1105	28.0529	28.1386	29.4228	29.7010	30.0421	30.3422	29.7714	29.7760	29.7453
2	4077.1956	29.75	39.75	30.4535	30.4699	34.2530	29.6330	29.5464	32.4471	32.5384	32.5943	29.4555	28.2240	28.1090	28.0568	28.1424	29.4252	29.7018	30.0441	30.3408	29.7700	29.7781	29.7471
3	4054.9862	29.75	39.75	30.4628	30.4636	34.2098	29.6329	29.5471	32.4244	32.5839	32.5666	29.4772	28.2484	28.1357	28.0794	28.1653	29.4250	29.7072	30.0484	30.3451	29.7737	29.7732	29.7433
4	4074.4821	29.75	39.75	30.4721	30.4671	34.2363	29.6336	29.5445	32.4321	32.5691	32.5881	29.4769	28.2527	28.1440	28.0838	28.1684	29.4258	29.7089	30.0500	30.3422	29.7729	29.7728	29.7430
5	4068.7903	29.75	39.75	30.4882	30.4067	33.9315	29.6453	29.5651	32.3504	32.4946	32.4338	29.7047	28.4471	28.3393	28.2948	28.3864	29.4594	29.7754	30.0977	30.3983	29.8529	29.7702	29.7403
6	4061.3815	29.75	39.75	30.4970	30.4031	33.9110	29.6436	29.5654	32.3317	32.5010	32.4575	29.7056	28.4484	28.3395	28.2955	28.3870	29.4613	29.7740	30.1005	30.4011	29.8539	29.7699	29.7406
7	4087.0825	29.75	39.75	30.5096	30.3270	33.5428	29.6575	29.5937	32.2123	32.4051	32.3111	29.9837	28.6782	28.5927	28.5605	28.6955	29.5026	29.8452	30.1524	30.4632	29.9419	29.7676	29.7385
8	4073.4310	29.75	39.75	30.5175	30.3279	33.5464	29.6583	29.5916	32.2079	32.4146	32.3144	29.9873	28.6782	28.5967	28.5684	28.6995	29.5050	29.8477	30.1549	30.4644	29.9444	29.7679	29.7389
9	4067.9075	29.75	39.75	30.5226	30.1723	32.9073	29.6796	29.6326	31.9377	32.2522	31.9993	30.3620	29.0049	28.9702	28.9658	29.1229	29.5772	29.9177	30.1894	30.5066	30.0334	29.7619	29.7359
10	4060.6394	29.75	39.75	30.5253	30.1687	32.8969	29.6812	29.6363	31.9331	32.2712	31.9739	30.3606	29.0071	28.9704	28.9650	29.1303	29.5794	29.9181	30.1927	30.5081	30.0368	29.7641	29.7374
11	4066.8873	29.75	39.75	30.5253	30.0878	32.5313	29.6940	29.6607	31.7401	32.1268	31.7441	30.5422	29.1542	29.1574	29.1631	29.3055	29.6243	29.9061	30.1673	30.4746	30.0423	29.7550	29.7343
12	4072.5738	29.75	39.75	30.5282	30.0870	32.4958	29.6950	29.6634	31.7150	32.1215	31.7579	30.5420	29.1503	29.1567	29.1621	29.3046	29.6272	29.9099	30.1686	30.4746	30.0432	29.7583	29.7363
13	4057.5912	29.75	39.75	30.5290	29.9537	31.7842	29.7204	29.7073	31.2484	31.5100	31.4336	30.7256	29.2454	29.3653	29.3917	29.4882	29.6951	29.8717	30.0875	30.3562	29.9679	29.7362	29.7342
14	4071.5790	29.75	39.75	30.5305	29.9544	31.7953	29.7211	29.7086	31.2392	31.5026	31.4249	30.7245	29.2462	29.3672	29.3923	29.4888	29.6956	29.8741	30.0904	30.3618	29.9679	29.7374	29.7358
15	4089.4781	29.75	39.75	30.5281	29.8922	31.4073	29.7327	29.7275	31.0035	31.0909	30.9627	30.6678	29.2112	29.4312	29.4930	29.5683	29.7191	29.7604	29.9469	30.1614	29.8304	29.7353	29.7352
16	4089.3667	29.75	39.75	30.5329	29.8924	31.4165	29.7350	29.7294	31.0079	31.0931	30.9560	30.6708	29.2142	29.4345	29.4927	29.5701	29.7236	29.7639	29.9515	30.1648	29.8354	29.7388	29.7391
1	5102.5188	29.75	39.75	30.5596	30.8628	36.7331	29.5711	29.4396	34.1577	34.3885	34.1715	29.3626	27.4541	27.2371	27.1393	27.2033	29.2503	29.7330	30.2879	30.6958	29.7613	29.7851	29.7424
2	5098.8766	29.75	39.75	30.5695	30.8667	36.7586	29.5734	29.4362	34.1621	34.3845	34.1696	29.3595	27.4593	27.2343	27.1375	27.2052	29.2524	29.7368	30.2903	30.6961	29.7616	29.7892	29.7448
3	5087.3338	29.75	39.75	30.5905	30.8522	36.6832	29.5736	29.4421	34.0963	34.3453	34.1414	29.3905	27.5038	27.2814	27.1729	27.2386	29.2536	29.7415	30.2964	30.7034	29.7717	29.7827	29.7398
4	5062.8223	29.75	39.75	30.5995	30.8486	36.6620	29.5741	29.4400	34.0690	34.3492	34.1710	29.3872	27.4998	27.2768	27.1726	27.2408	29.2558	29.7458	30.3059	30.7062	29.7728	29.7829	29.7409
5	5089.7935	29.75	39.75	30.6101	30.7667	36.2726	29.5869	29.4676	33.9810	34.2445	33.9729	29.7208	27.7725	27.5623	27.4751	27.5780	29.3032	29.8339	30.3732	30.7850	29.8863	29.7806	29.7383
6	5072.5807	29.75	39.75	30.6196	30.7682	36.2669	29.5871	29.4686	33.9627	34.2471	33.9751	29.7259	27.7729	27.5664	27.4800	27.5821	29.3025	29.8353	30.3753	30.7937	29.8885	29.7824	29.7396
7	5073.0960	29.75	39.75	30.6256	30.4225	34.7624	29.6417	29.5660	33.3765	33.9011	33.2997	30.7319	28.6005	28.5178	28.5012	28.7187	29.4758	30.0604	30.5364	30.9749	30.1820	29.7769	29.7367
8	5099.6999	29.75	39.75	30.6290	30.4199	34.7332	29.6423	29.5695	33.3522	33.8631	33.2487	30.7259	28.6042	28.5221	28.5020	28.7170	29.4777	30.0650	30.5419	30.9800	30.1849	29.7799	29.7397
9	5081.9471	29.75	39.75	30.6244	30.2537	33.9198	29.6702	29.6209	32.8853	33.5489	32.8433	31.0670	28.8752	28.8670	28.8799	29.0801	29.5704	30.0607	30.5010	30.9224	30.2081	29.7637	29.7369
10	5091.6073	29.75	39.75	30.6253	30.2533	33.9124	29.6712	29.6210	32.8946	33.5479	32.8439	31.0639	28.8831	28.8727	28.8818	29.0794	29.5714	30.0610	30.4964	30.9192	30.2112	29.7685	29.7394
11	5106.4273	29.75	39.75	30.6226	30.0598	32.8772	29.7048	29.6847	32.2148	32.6835	32.4783	31.3440	28.9328	29.1283	29.1749	29.3340	29.6675	30.0216	30.4049	30.7863	30.1122	29.7383	29.7381
12	5110.7334	29.75	39.75	30.6242	30.0613	32.8923	29.7063	29.6852	32.2183	32.7012	32.5287	31.3506	28.9361	29.1299	29.1771	29.3336	29.6687	30.0280	30.4057	30.7896	30.1125	29.7408	29.7404
13	5075.6708	29.75	39.75	30.6231	29.9556	32.2243	29.7261	29.7175	31.8133	31.9480	31.6855	31.2283	28.9216	29.2319	29.3312	29.4669	29.7111	29.8442	30.1633	30.4678	29.9104	29.7378	29.7383
14	5078.5920	29.75	39.75	30.6235	29.9572	32.2229	29.7268	29.7175	31.8265	31.9487	31.6721	31.2376	28.9145	29.2303	29.3305	29.4675	29.7098	29.8511	30.1718	30.4738	29.9082	29.7395	29.7399
15	5105.5147	29.75	39.75	30.6404	30.3501	34.4249	29.6511	29.5876	33.1836	33.7911	33.1144	30.8791	28.7346	28.6838	28.6868	28.9114	29.5107	30.0784	30.5491	30.9828	30.2089	29.7760	29.7368
16	5094.3310	29.75	39.75	30.6495	30.3491	34.4300	29.6521	29.5889	33.1825	33.7968	33.1196	30.8853	28.7343	28.6861	28.6838	28.9141	29.5132	30.0828	30.5438	30.9946	30.2116	29.7773	29.7396
1	6112.1901	29.75	39.75	30.6761	31.3522	39.9283	29.5008	29.3167	36.1908	36.3977	36.2027	29.3227	26.5146	26.1808	26.0253	26.0718	29.0590	29.8340	30.6122	31.1599	29.7396	29.7742	29.7406
2	6108.5497	29.75	39.75	30.6886	31.3549	39.9310	29.5039	29.3243	36.1852	36.4118	36.1870	29.3245	26.5147	26.1795	26.0286	26.0806	29.0630	29.8543	30.6164	31.1607	29.7411	29.7769	29.7428
3	6117.7989	29.75	39.75	30.7015	31.3499	39.8745	29.5054	29.3184	36.2142	36.4002	36.2420	29.3647	26.5556	26.2226	26.0635	26.1141	29.0665	29.9006	30.6498	31.2009	29.7560	29.7695	29.7416
4	6121.9189	29.75	39.75	30.7096	31.3492	39.9162	29.5047	29.3218	36.1916	36.3939	36.2108	29.3651	26.5481	26.2187	26.0619	26.1092	29.0689	29.9141	30.6492	31.2048	29.7564	29.7779	29.7431
5	6107.4616	29.75	39.75	30.7294	31.2015	39.2147	29.5245	29.3584	35.9192	36.3263	35.9034	29.8756	26.9384	26.6496	26.5179	26.6106	29.1393	30.0595	30.7673	31.3065	29.9386	29.7753	29.7401
6	6114.4011	29.75	39.75	30.7391	31.1963	39.1993	29.5275	29.3633	35.8982	36.3210	35.9084	29.8825	26.9345	26.6486	26.5223	26.6049	29.1403	30.0609	30.7734	31.3242	29.9415	29.7702	29.7417
7	6104.1995	29.75	39.75	30.7503	31.0317	38.4412	29.5513	29.4115	35.5653	36.1552	35.6344	30.4182	27.3504	27.1069	27.0173	27.1578	29.2186	30.2228	30.8896	31.4613	30.1127	29.7749	29.7392
8	6121.3567	29.75	39.75	30.7597	31.0374	38.4693	29.5520	29.4094	35.5682	36.1831	35.5335	30.4244	27.3445	27.1010	27.0140	27.1439	29.2187	30.2256	30.8942	31.4576	30.1184	29.7761	29.7409
9	6112.2211	29.75	39.75	30.7508	30.7048	37.0131	29.5959	29.4902	35.0584	35.7820	34.8606	31.2600	28.0727	27.9711	27.9425	28.2014	29.3630	30.4138	31.0254	31.6050	30.3535	29.7691	29.7386
10	6112.7506	29.75	39.75	30.7489	30.7065	37.0077	29.5985	29.4917	35.0239	35.7647	34.8319	31.2617	28.0721	27.9651	27.9431	28.2051	29.3650	30.4249	31.0361	31.5974	30.3609	29.7757	29.7413
11	6103.7959	29.75	39.75	30.7446	30.4995	35.9278	29.6332	29.5554	34.5092	35.4584	34.3603	31.6840	28.4510	28.4439	28.4614	28.7615	29.4764	30.4269	30.9978	31.5567	30.4036	29.7480	29.7367
12	6105.0690	29.75	39.75	30.7458	30.5002	35.9382	29.6320	29.5581	34.4873	35.4439	34.3270	31.6856	28.4511	28.4408	28.4630	28.7591	29.4754	30.4231	31.0006	31.5653	30.4027	29.7469	29.7358
13	6106.1253	29.75	39.75	30.7385	30.1779	34.1137	29.6892	29.6600	33.2606	34.0312	33.6040	32.0843	28.5509	28.8681	28.9411	29.1600	29.6358	30.2922	30.7814	31.2508	30.2453	29.7307	29.7321
14	6120.3265	29.75	39.75	30.7392	30.1822	34.1544	29.6893	29.6602	33.3024	34.0674	33.6390	32.0910	28.5489	28.8623	28.9388	29.1578	29.6352	30.2966	30.7840	31.2613	30.2489	29.7331	29.7337
15	6124.9183	29.75	39.75	30.7363	30.0455	33.2817	29.7160	29.7030	32.8411	33.0283	32.6512	31.9580	28.5242	28.9968	29.1680	29.3918	29.7004	30.0475	30.4578	30.8488	29.9988	29.7350	29.7352
16	6120.6388	29.75	39.75	30.7369	30.0435	33.2666	29.7168	29.7036	32.8465	33.0158	32.6574	31.9609	28.5286	28.9953	29.1643	29.3881	29.7019	30.0552	30.4641	30.8469	29.9994	29.7367	29.7369

Run #	RPM	Pnoz1	Pnoz2	Pnoz3	Pin	Pin (Flange)	Pout (Flange)	Pout (Vena)	Tin CFF (2 o/c)	Tin CFF (11 o/c)	Tin TTR (8 o/c)	Tin TTR (5 o/c)	Tout TTR	Tin Orifice	Tout CFF (Bot)	Tout CFF (Mid)	Tout CFF (Top)	TTR Mass Flow (lbm/s)	Turbine Power (HP)	CFF Mass Flow (lbm/s)	Pi CFF	Tau CFF	CFF Efficiency
1	2037.5868	29.7547	29.7636	29.7491	35.5871	29.7941	35.5559	35.5609	535.1723	534.9913	537.6913	537.6368	534.1651	540.4440	539.8481	540.5055	539.7936	1.0589	-0.8892	0.7459	1.0219	1.0093	0.6673
2	2035.0298	29.7560	29.7602	29.7513	35.6379	29.7926	35.5798	35.5828	535.0423	534.7434	538.0059	537.9479	534.4059	541.5268	539.6636	540.3333	539.6425	1.5245	-1.3066	1.0917	1.0223	1.0093	0.6783
3	2016.5357	29.7524	29.7570	29.7492	35.4272	29.7879	35.3864	35.3725	535.4044	535.3218	538.1712	538.1501	534.6274	540.7534	540.4071	540.9397	540.2173	1.5151	-1.2847	1.0377	1.0219	1.0096	0.6434
4	2027.5409	29.7528	29.7572	29.7483	35.4235	29.7883	35.3543	35.3861	535.5134	535.2567	538.1958	538.1466	534.7241	540.3825	540.0555	540.7798	540.1013	1.2580	-1.0408	0.8801	1.0221	1.0092	0.6798
5	2025.6448	29.7532	29.7573	29.7489	35.4551	29.7848	35.4047	35.4277	535.5503	535.3024	538.2872	538.2995	534.9790	540.4036	540.0925	540.5934	540.0098	1.0795	-0.8587	0.7445	1.0210	1.0090	0.6638
6	2027.7396	29.7534	29.7595	29.7485	35.4294	29.7851	35.4207	35.4197	535.6628	535.5134	538.5403	538.5315	535.1882	541.3880	540.2753	540.7798	540.1768	0.6505	-0.5226	0.4515	1.0211	1.0090	0.6642
7	2038.8747	29.7543	29.7570	29.7505	35.2668	29.7808	35.2318	35.2456	536.1866	536.0794	538.7794	538.7583	535.5679	541.3054	540.8712	541.1841	540.5231	0.9484	-0.7286	0.6423	1.0200	1.0088	0.6420
8	2030.9244	29.7570	29.7619	29.7517	35.2577	29.7831	35.2236	35.2354	536.1180	535.8825	538.7548	538.7460	535.5591	540.9503	540.3843	540.8923	540.2929	0.9722	-0.7446	0.6860	1.0202	1.0084	0.6783
9	2059.5485	29.7616	29.7649	29.7574	35.0078	29.7802	34.9664	34.9626	536.3747	536.2024	538.7811	538.7565	535.9036	540.8149	540.4546	540.8641	540.1997	1.3710	-0.9428	0.9314	1.0180	1.0079	0.6485
10	2021.0460	29.7634	29.7664	29.7598	34.9305	29.7819	34.8707	34.8882	536.4573	536.2042	538.9903	538.9534	536.1884	541.7026	540.3878	540.7147	540.1434	1.3246	-0.8849	0.9026	1.0182	1.0076	0.6789
11	2039.8937	29.7669	29.7685	29.7638	33.8921	29.7795	33.8417	33.8796	536.7966	536.5452	539.1573	539.1538	536.6032	541.3352	540.4932	540.8395	540.1610	0.7202	-0.4412	0.4803	1.0164	1.0071	0.6515
12	2046.7967	29.7693	29.7716	29.7666	33.8835	29.7821	33.8646	33.8566	536.8352	536.6612	539.1503	539.1257	536.5417	541.1261	540.6128	540.9397	540.3034	1.0458	-0.6517	0.7016	1.0159	1.0072	0.6280
13	2049.6075	29.7740	29.7745	29.7715	33.5204	29.7797	33.4941	33.5254	537.0567	536.8036	539.3208	539.2751	537.0233	541.6815	540.7024	540.8343	540.0907	0.4581	-0.2501	0.2884	1.0132	1.0067	0.5585
14	2033.5813	29.7766	29.7771	29.7746	33.5465	29.7824	33.5118	33.5050	537.2272	536.9179	539.4315	539.4227	537.1569	542.1421	540.8237	540.8817	540.1452	1.2856	-0.7005	0.8235	1.0137	1.0066	0.5895
15	2078.2173	29.7780	29.7781	29.7768	33.3257	29.7787	33.2848	33.3117	537.3889	537.1745	539.4843	539.4526	537.3362	541.4231	540.8360	540.8993	540.2946	0.7523	-0.3850	0.4725	1.0105	1.0063	0.4714
16	2058.0510	29.7807	29.7804	29.7791	33.3064	29.7818	33.2993	33.2729	537.4505	537.1446	539.4473	539.4104	537.3854	541.1542	540.7499	540.8237	540.2243	1.1532	-0.5656	0.7137	1.0105	1.0061	0.4855
1	3059.8200	29.7018	29.7141	29.6954	34.3587	29.7907	34.3251	34.3095	537.1024	536.4819	540.0995	540.1276	533.0682	541.9628	547.2925	548.6811	547.7794	1.4151	-2.3928	0.8961	1.0532	1.0207	0.7193
2	3066.4974	29.7062	29.7180	29.6989	34.3685	29.7946	34.3266	34.3115	537.0462	536.4889	540.1680	540.1470	533.0454	541.3546	547.0745	548.7497	547.7354	1.5226	-2.5989	0.9768	1.0533	1.0207	0.7240
3	3054.0727	29.7060	29.7183	29.6986	34.3150	29.7943	34.2456	34.2570	536.9776	536.3923	540.1083	540.1030	533.0964	540.6409	546.9110	548.4333	547.5034	1.5362	-2.5842	0.9850	1.0532	1.0204	0.7322
4	3051.4630	29.7070	29.7195	29.7019	34.3255	29.7953	34.2705	34.2596	537.0620	536.4749	539.9237	539.9430	532.9540	540.1786	547.2679	548.6952	547.6563	1.6366	-2.7414	1.0286	1.0531	1.0207	0.7195
5	3059.3829	29.7121	29.7228	29.7064	34.0516	29.7916	34.0127	33.9809	537.0444	536.5768	540.0942	540.0696	533.3477	541.0874	547.0675	548.2540	547.2327	1.6857	-2.7244	1.0602	1.0512	1.0199	0.7205
6	3059.7105	29.7132	29.7242	29.7066	34.0717	29.7918	34.0014	34.0031	537.0057	536.5048	540.3368	540.3245	533.5042	541.9206	546.9391	548.2733	547.1483	1.6599	-2.7196	1.0592	1.0514	1.0199	0.7239
7	3051.6027	29.7219	29.7313	29.7175	33.6669	29.7920	33.5962	33.5979	537.0919	536.6278	540.0802	540.0995	533.8962	540.5759	546.5155	547.4788	546.4944	1.6572	-2.4634	1.0295	1.0492	1.0186	0.7440
8	3066.4504	29.7262	29.7394	29.7189	33.6829	29.7964	33.6090	33.6137	537.0708	536.6454	540.2981	540.3157	533.9788	541.6341	546.6069	547.6686	546.6649	1.6583	-2.5186	1.0368	1.0495	1.0189	0.7377
9	3066.2310	29.7428	29.7506	29.7369	33.1301	29.7915	33.0962	33.1095	537.2009	536.9038	540.4247	540.3790	534.9561	541.3669	545.5223	546.5999	545.6296	0.9073	-1.1858	0.5574	1.0437	1.0165	0.7449
10	3062.1466	29.7449	29.7517	29.7399	33.1213	29.7944	33.1178	33.1036	537.1938	536.8388	540.2735	540.2524	534.8542	540.8800	545.5346	546.5348	545.5557	0.8440	-1.0957	0.5153	1.0439	1.0165	0.7489
11	3066.4504	29.7552	29.7593	29.7518	32.9390	29.7867	32.8919	32.8892	537.6245	537.2940	540.1663	540.1628	535.4009	540.4405	545.4784	546.2395	544.9581	1.3962	-1.5962	0.8212	1.0388	1.0151	0.7260
12	3059.5234	29.7574	29.7619	29.7549	32.9462	29.7886	32.8965	32.8959	537.7317	537.4294	540.0837	540.0661	535.3710	540.7042	545.5610	546.3011	544.9897	1.4034	-1.5844	0.8214	1.0388	1.0149	0.7315
13	3063.0845	29.7692	29.7716	29.7671	32.8808	29.7825	32.8268	32.8076	537.7124	537.3450	540.4159	540.4001	536.4679	542.0243	544.8350	545.2235	544.0405	1.6835	-1.5920	0.9250	1.0316	1.0133	0.6693
14	3053.4355	29.7704	29.7726	29.7685	32.8262	29.7838	32.8188	32.8037	537.6561	537.2958	540.3930	540.3930	536.5030	541.6692	544.9845	545.2903	544.0757	0.9444	-0.8817	0.5027	1.0314	1.0136	0.6518
15	3055.1924	29.7773	29.7774	29.7756	32.8609	29.7813	32.8026	32.8336	537.9813	537.6596	540.2929	540.2964	536.9565	540.9081	544.6452	544.9018	543.9175	1.0374	-0.8311	0.5193	1.0235	1.0124	0.5379
16	3059.3986	29.7800	29.7801	29.7782	32.8711	29.7836	32.8192	32.8397	538.0165	537.8020	540.2946	540.2788	536.9583	540.7376	544.7050	544.9739	544.0563	1.1126	-0.8887	0.5553	1.0237	1.0124	0.5412
1	4075.7552	29.6035	29.6295	29.5935	35.0702	29.7597	34.9763	34.9709	537.3081	536.5751	540.7587	540.7059	528.8829	541.7132	554.8212	558.3438	556.3680	2.0218	-5.7498	1.2242	1.0996	1.0364	0.7548
2	4077.1956	29.6066	29.6293	29.5892	35.0863	29.7653	34.9727	34.9675	537.1710	536.4608	540.6778	540.6145	528.7721	541.2192	555.0497	558.2735	556.4507	2.2098	-6.2975	1.3269	1.0993	1.0368	0.7439
3	4054.9862	29.6015	29.6247	29.5914	35.0148	29.7586	34.9085	34.9052	537.0444	536.2007	540.4423	540.4054	528.6983	540.6163	555.1587	557.8411	556.2450	2.1224	-5.9726	1.2574	1.0992	1.0369	0.7425
4	4074.4821	29.6036	29.6260	29.5925	35.0248	29.7590	34.9095	34.9198	537.0251	536.2516	540.3772	540.3473	528.6122	540.3966	555.2782	558.0309	556.4559	2.0791	-5.8632	1.2246	1.0994	1.0372	0.7381
5	4068.7903	29.6153	29.6337	29.6017	34.9406	29.7557	34.8326	34.8476	537.3011	536.5487	540.7815	540.7253	529.3979	541.5145	555.0971	557.4368	555.5190	1.9545	-5.3266	1.1624	1.0953	1.0356	0.7409
6	4061.3815	29.6145	29.6349	29.6066	34.9171	29.7559	34.8288	34.8121	537.4417	536.7772	540.6374	540.6216	529.4155	541.2280	555.1921	557.4948	555.5313	2.0746	-5.5834	1.2268	1.0954	1.0353	0.7474
7	4087.0825	29.6305	29.6467	29.6203	34.4174	29.7519	34.3607	34.3500	537.4241	536.8950	540.6356	540.5864	530.1784	540.7270	554.5610	556.6897	554.8300	1.6555	-4.1450	0.9489	1.0906	1.0339	0.7404
8	4073.4310	29.6317	29.6473	29.6228	34.4227	29.7531	34.3160	34.3412	537.4891	536.9020	540.5354	540.4809	530.1221	540.5231	554.4784	556.5456	554.7016	1.8184	-4.5327	1.0465	1.0907	1.0336	0.7477
9	4067.9075	29.6573	29.6689	29.6500	33.6589	29.7457	33.6084	33.5940	537.6104	537.0567	540.3473	540.3263	531.4774	540.1329	553.0001	554.6296	552.6942	1.6081	-3.4191	0.8844	1.0812	1.0300	0.7521
10	4060.6394	29.6584	29.6705	29.6517	33.6504	29.7478	33.5845	33.5937	537.6860	537.0813	540.5126	540.4845	531.6005	540.7850	553.0669	554.7315	552.6415	1.5034	-3.2105	0.8311	1.0809	1.0300	0.7507
11	4066.8873	29.6743	29.6832	29.6699	33.1181	29.7367	33.0660	33.0418	538.1220	537.6298	540.8044	540.7710	532.7641	541.8661	552.1475	553.8052	551.6923	1.7255	-3.3227	0.9436	1.0739	1.0273	0.7543
12	4072.5738	29.6754	29.6851	29.6735	33.1314	29.7389	33.0677	33.0672	538.2046	537.7159	540.7991	540.7622	532.6973	541.5110	552.4692	553.9405	551.7661	1.5855	-3.0759	0.8680	1.0736	1.0274	0.7472
13	4057.5912	29.7058	29.7102	29.7031	32.8772	29.7305	32.7992	32.8162	538.2485	537.7968	540.6532	540.6286	534.5026	540.9063	550.6165	551.3020	549.3966	1.5408	-2.2700	0.7618	1.0567	1.0231	0.6877
14	4071.5790	29.7074	29.7112	29.7065	32.8831	29.7318	32.8165	32.8365	538.2345	537.8003	540.5899	540.5776	534.4815	540.6356	550.6182	551.3003	549.3667	1.3501	-1.9773	0.6638	1.0563	1.0231	0.6842
15	4089.4781	29.7219	29.7233	29.7199	32.7382	29.7316	32.6782	32.6787	538.4120	538.0235	540.7235	540.7323	535.5766	541.8925	549.6638	550.3141	548.8622	1.5172	-1.8758	0.6859	1.0434	1.0212	0.5762
16	4089.3667	29.7252	29.7270	29.7237	32.7336	29.7355	32.6857	32.6857	538.4999	538.1606	540.7516	540.8149	535.6593	541.8802	549.8466	550.4337	548.9536	1.3633	-1.6765	0.6120	1.0433	1.0212	0.5744
1	5102.5188	29.5284	29.5648	29.5136	38.0549	29.7660	37.9066	37.8904	536.8247	535.5837	540.9134	540.8800	522.8307	541.7923	565.0815	569.8241	567.4704	2.7019	-11.7151	1.5618	1.1604	1.0583	0.7451
2	5098.8766	29.5282	29.5644	29.5079	38.0837	29.7685	37.9364	37.9333	536.9864	535.9370	541.1524	541.1032	522.9995	542.2229	565.8391	570.4182	567.9802	2.5846	-11.2449	1.4819	1.1604	1.0589	0.7369
3	5087.3338	29.5287	29.5623	29.5115	37.9258	29.7611	37.7333	37.7563	536.8317	535.7085	540.9696	540.8993	523.0575	541.3827	564.8688	569.7257	567.2718	2.7382	-11.7484	1.5781	1.1588	1.0578	0.7436
4	5062.8223	29.5282	29.5639	29.5109	37.9283	29.7637	37.7357	37.7061	536.8388	535.5942	540.8272	540.7534	522.9468	541.1366	564.8970	569.5815	567.2647	3.1310	-13.4085	1.8004	1.1589	1.0579	0.7437
5	5089.7935	29.5449	29.5748	29.5272	37.5780	29.7616	37.3908	37.3990	536.9196	536.1761	540.6690	540.6409	523.4354	540.6110	564.5612	568.8802	566.0624	2.8022	-11.5806	1.6109	1.1537	1.0558	0.7469
6	5072.5807	29.5482	29.5768	29.5285	37.5453	29.7617	37.3786	37.3817	536.9442	535.9528	540.5319	540.4950	523.3757	540.3966	564.7352	568.7413	566.0870	2.6793	-11.0200	1.5269	1.1535	1.0561	0.7430
7	5073.0960	29.6075	29.6313	29.5997	35.8830	29.7576	35.7553	35.7586	537.5630	536.9794	541.1050	541.0628	527.4977	542.0559	562.0845	564.8970	561.6046	2.2843	-7.4484	1.2127	1.1325	1.0476	0.7597
8	5099.6999	29.6119	29.6342	29.6068	35.8619	29.7548	35.7438	35.7466	537.5929	537.0093	541.0680	541.0188	527.4274	541.7009	562.2638	565.1096	561.7680	2.2007	-7.1916	1.1639	1.1311	1.0479	0.7477
9	5081.9471	29.6445	29.6610	29.6423	34.8949	29.7390	34.7747	34.7810	537.9286	537.4276	540.7815	540.7358	528.8723	540.9345	559.9856	562.7419	559.2579	2.1595	-6.1605	1.1168	1.1163	1.0427	0.7468
10	5091.6073	29.6475	29.6630	29.6439	34.8691	29.7423	34.7957	34.7739	538.0815	537.6157	540.7112	540.7024	528.8319	540.6567	560.1948	562.8684	559.4108	1.9769	-5.6341	1.0217	1.1164	1.0427	0.7478
11	5106.4273	29.6913	29.6991	29.6888	33.9675	29.7350	33.9154	33.9112	538.0393	537.4557	540.6602	540.7341	531.5741	540.9854	557.4878	559.1331	555.9831	1.5050	-3.2952	0.6939	1.0931	1.0368	0.6999
12	5110.7334	29.6939	29.7011	29.6931	33.9907	29.7377	33.9373	33.9047	537.9602	537.4522	541.0153	541.0030	531.7798	542.1139	557.3225	559.2649	556.1149	1.8541	-4.1070	0.8616	1.0939	1.0369	0.7028
13	5075.6708	29.7153	29.7191	29.7138	33.4538	29.7356	33.3801	33.3802	538.3522	538.0956	540.9362	540.9696	533.4620	541.5233	555.7792	557.0975	554.7210	1.7046	-3.0645	0.7238	1.0704	1.0328	0.5992
14	5078.5920	29.7174	29.7205	29.7149	33.4357	29.7370	33.3637	33.3459	538.4893	538.2960	540.9485	540.9046	533.3636	541.1805	555.9251	557.1819	554.9161	1.8790	-3.4106	0.8067	1.0704	1.0327	0.6002
15	5105.5147	29.6244	29.6426	29.6176	35.3175	29.7520	35.1969	35.1954	538.0253	537.4259	540.6128	540.5706	527.5751	540.3720	561.9087	564.4206	560.9841	2.2490	-7.0258	1.1846	1.1264	1.0460	0.7526
16	5094.3310	29.6265	29.6452	29.6201	35.3380	29.7563	35.2080	35.2159	537.8741	537.2483	540.4932	540.4563	527.4239	540.2261	561.4903	564.1815	560.7714	2.2496	-7.0463	1.1941	1.1265	1.0457	0.7566
1	6112.1901	29.4408	29.4949	29.4138	41.3641	29.7373	41.1243	41.1041	536.5663	535.0686	541.3528	541.3440	516.2354	542.0507	577.7694	584.2821	580.9774	3.5306	-21.2796	1.9620	1.2331	1.0843	0.7314
2	6108.5497	29.4451	29.4987	29.4192	41.3274	29.7394	41.1225	41.1479	536.4327	534.8261	541.2280	541.2245	516.0596	541.6657	577.9399	584.0905	580.9124	2.9392	-17.7527	1.6310	1.2328	1.0847	0.7277
3	6117.7989	29.4444	29.4930	29.4198	41.5021	29.7365	41.2246	41.2717	536.3114	534.9263	541.1770	541.1067	516.0491	541.3001	577.7149	583.9833	580.8368	3.3333	-20.0743	1.8494	1.2337	1.0844	0.7324
4	6121.9189	29.4463	29.4971	29.4249	41.4745	29.7389	41.3061	41.2248	536.1655	534.5571	541.1225	541.0346	515.9647	541.3335	577.3845	583.4524	580.4940	3.4678	-20.9015	1.9318	1.2330	1.0842	0.7322
5	6107.4616	29.4706	29.5146	29.4525	40.5358	29.7356	40.3310	40.3342	536.3677	535.1759	540.7727	540.7411	516.7557	540.8852	576.8817	582.5366	578.5464	3.0853	-17.7721	1.7004	1.2245	1.0813	0.7327
6	6114.4011	29.4730	29.5197	29.4532	40.5683	29.7377	40.3210	40.3483	536.2323	534.7804	540.8202	540.7499	516.7470	540.7007	576.1786	582.3573	578.4919	3.2235	-18.5968	1.7812	1.2240	1.0812	0.7319
7	6104.1995	29.5009	29.5394	29.4863	39.6369	29.7343	39.4108	39.4092	536.4257	535.2761	541.2368	541.2579	518.9688	542.5886	575.0202	580.0616	576.0169	3.2351	-17.2974	1.7501	1.2138	1.0769	0.7406
8	6121.3567	29.5023	29.5405	29.4833	39.6347	29.7362	39.4145	39.5181	536.8212	535.6786	541.5251	541.4829	519.0040	542.4216	575.4491	580.8245	576.5108	2.3232	-12.5453	1.2643	1.2131	1.0771	0.7358
9	6112.2211	29.5587	29.5893	29.5471	38.1630	29.7344	37.9652	37.9653	537.4470	536.5663	541.2333	541.1805	522.0538	541.5057	572.9513	577.4091	572.9565	2.9635	-13.6223	1.5163	1.1926	1.0697	0.7405
10	6112.7506	29.5590	29.5907	29.5487	38.1319	29.7372	37.9417	37.9438	537.4575	536.5311	541.1155	541.0628	521.9430	541.3018	572.4942	577.0329	572.6929	2.8910	-13.2842	1.4928	1.1916	1.0690	0.7439
11	6103.7959	29.5987	29.6228	29.5931	36.9070	29.7295	36.7385	36.7375	538.0657	537.3714	540.9520	540.9397	523.6745	540.8641	570.2108	574.7372	569.3565	2.7020	-11.2003	1.3841	1.1751	1.0627	0.7524
12	6105.0690	29.5972	29.6225	29.5931	36.9013	29.7285	36.7387	36.7221	537.9989	537.3960	540.8061	540.7850	523.6534	540.7270	570.0807	574.5052	569.1843	2.7781	-11.4295	1.4191	1.1743	1.0624	0.7525
13	6106.1253	29.6663	29.6779	29.6623	36.3770	29.7271	36.2870	36.2843	538.0622	537.2589	540.9011	540.9468	528.2641	541.0751	565.8075	568.4284	563.9882	1.9912	-6.0498	0.8871	1.1334	1.0528	0.6890
14	6120.3265	29.6677	29.6789	29.6664	36.3933	29.7295	36.2946	36.3011	538.1009	537.2782	541.1014	541.1225	528.5014	542.1227	565.6335	568.3124	564.1481	1.9849	-6.0075	0.8832	1.1346	1.0527	0.6971
15	6124.9183	29.7000	29.7069	29.6985	35.2053	29.7323	35.1073	35.1328	538.8638	538.4436	541.2034	541.1911	530.6600	541.9979	564.2940	566.1169	562.7278	1.7337	-4.3844	0.7101	1.1054	1.0478	0.6080
16	6120.6388	29.7026	29.7088	29.7007	35.1857	29.7342	35.1170	35.1331	539.0940	538.6968	541.2315	541.2596	530.6864	541.7061	564.3573	566.2013	562.9177	1.4805	-3.7519	0.6107	1.1053	1.0475	0.6111

Run #	RPM	CFF Corrected Mass Flow	Corrected Power (HP)	Corrected Speed (RPM)	X1	mdot1	X2	mdot2	X3	mdot3	Computed MA Mdot	Computed MA Power (HP)	Corrected Computed MA	Corrected Computed MA HP	Ttbar Out	Ptbar Out	Pt_bar	Tt_bar	Mach Exit	Temp Exit	Velocity Exit (m/s)	Corrected Thrust (lbf)	M_dot_Inlet	Corrected Computed MA Mdot(lbm/s)
1	2037.5868	0.7606	1.2450	2008.0863	0.0798	0.2731	0.0816	0.1595	0.0838	0.2870	0.7196	1.4158	0.7345	1.4009	539.9731	30.4231	30.4231	539.9731	0.1835	532.7943	63.3364	43.7031	0.8340	0.8513
2	2035.0298	1.1131	1.8297	2005.9206	0.0807	0.2762	0.0824	0.1611	0.0845	0.2894	0.7267	1.4212	0.7417	1.4065	539.8040	30.4355	30.4355	539.8040	0.1853	532.4898	63.9305	44.1009	0.8339	0.8511
3	2016.5357	1.0586	1.7984	1986.8180	0.0794	0.2717	0.0811	0.1585	0.0833	0.2852	0.7154	1.5219	0.7305	1.5057	540.4530	30.4207	30.4207	540.4530	0.1825	533.3460	63.0187	44.9166	0.8613	0.8794
4	2027.5409	0.8979	1.4569	1997.6200	0.0797	0.2727	0.0814	0.1592	0.0837	0.2868	0.7187	1.4516	0.7339	1.4361	540.2333	30.4260	30.4260	540.2333	0.1833	533.0671	63.2806	45.1631	0.8624	0.8806
5	2025.6448	0.7595	1.2019	1995.6749	0.0740	0.2536	0.0766	0.1500	0.0785	0.2692	0.6728	1.4156	0.6870	1.4004	540.1730	30.3955	30.3955	540.1730	0.1714	533.8995	59.2081	42.0930	0.8590	0.8772
6	2027.7396	0.4607	0.7314	1997.4370	0.0740	0.2536	0.0764	0.1495	0.0792	0.2715	0.6746	1.4101	0.6889	1.3946	540.3501	30.4007	30.4007	540.3501	0.1719	534.0352	59.4030	41.9335	0.8528	0.8709
7	2038.8747	0.6556	1.0190	2007.3848	0.0673	0.2309	0.0712	0.1394	0.0719	0.2465	0.6168	1.3840	0.6302	1.3680	540.8116	30.3666	30.3666	540.8116	0.1570	535.5316	54.3181	38.3099	0.8516	0.8701
8	2030.9244	0.7000	1.0415	1999.8048	0.0678	0.2327	0.0712	0.1396	0.0728	0.2499	0.6222	1.2771	0.6355	1.2624	540.4640	30.3767	30.3767	540.4640	0.1583	535.0994	54.7512	37.3496	0.8238	0.8415
9	2059.5485	0.9505	1.3180	2027.4452	0.0562	0.1929	0.0627	0.1231	0.0611	0.2099	0.5260	1.1299	0.5373	1.1164	540.4570	30.3130	30.3130	540.4570	0.1338	536.6155	46.3313	29.9509	0.7805	0.7973
10	2021.0460	0.9212	1.2370	1989.4646	0.0569	0.1956	0.0631	0.1239	0.0614	0.2111	0.5306	1.0690	0.5421	1.0561	540.3740	30.3211	30.3211	540.3740	0.1349	536.4707	46.7027	29.4473	0.7612	0.7776
11	2039.8937	0.4903	0.6164	2007.3814	0.0496	0.1706	0.0559	0.1099	0.0528	0.1815	0.4621	0.9555	0.4721	0.9436	540.4529	30.2688	30.2688	540.4529	0.1174	537.4896	40.6922	24.5200	0.7272	0.7431
12	2046.7967	0.7161	0.9105	2014.0292	0.0489	0.1681	0.0554	0.1087	0.0522	0.1793	0.4561	0.9262	0.4661	0.9145	540.5767	30.2585	30.2585	540.5767	0.1160	537.6851	40.1971	23.1953	0.6964	0.7115
13	2049.6075	0.2944	0.3493	2016.4533	0.0351	0.1206	0.0429	0.0842	0.0423	0.1454	0.3502	0.8087	0.3579	0.7983	540.5234	30.1842	30.1842	540.5234	0.0897	538.7877	31.1436	16.7218	0.6479	0.6620
14	2033.5813	0.8407	0.9782	2000.4211	0.0352	0.1210	0.0431	0.0847	0.0440	0.1513	0.3570	0.7531	0.3648	0.7433	540.6075	30.2011	30.2011	540.6075	0.0917	538.7938	31.8351	16.1809	0.6132	0.6266
15	2078.2173	0.4824	0.5375	2043.9312	0.0262	0.0902	0.0321	0.0631	0.0287	0.0987	0.2520	0.6965	0.2575	0.6872	540.6581	30.1045	30.1045	540.6581	0.0644	539.7629	22.3659	11.0075	0.5936	0.6067
16	2058.0510	0.7287	0.7895	2024.0678	0.0263	0.0903	0.0323	0.0634	0.0298	0.1023	0.2560	0.6393	0.2617	0.6308	540.5827	30.1067	30.1067	540.5827	0.0655	539.6574	22.7387	10.5585	0.5601	0.5724
1	3059.8200	0.9174	3.3524	3010.7115	0.1225	0.4186	0.1250	0.2439	0.1263	0.4319	1.0944	4.7148	1.1214	4.6684	547.7882	31.2821	31.2821	547.7882	0.2807	531.0492	96.7143	98.6351	1.2307	1.2611
2	3066.4974	0.9999	3.6409	3017.3509	0.1225	0.4184	0.1254	0.2448	0.1264	0.4326	1.0958	4.5913	1.1228	4.5458	547.7011	31.2879	31.2879	547.7011	0.2811	530.9247	96.8223	96.7147	1.2054	1.2351
3	3054.0727	1.0082	3.6206	3005.3567	0.1218	0.4163	0.1252	0.2445	0.1254	0.4292	1.0900	4.5330	1.1167	4.4884	547.4788	31.2823	31.2823	547.4788	0.2794	530.9011	96.2470	96.1501	1.2057	1.2352
4	3051.4630	1.0528	3.8403	3002.5550	0.1219	0.4166	0.1244	0.2428	0.1259	0.4308	1.0902	4.5593	1.1169	4.5138	547.7342	31.2846	31.2846	547.7342	0.2795	531.1363	96.3057	95.2552	1.1936	1.2229
5	3059.3829	1.0849	3.8153	3010.2297	0.1143	0.3919	0.1177	0.2306	0.1191	0.4090	1.0315	4.2947	1.0565	4.2507	547.3955	31.2362	31.2362	547.3955	0.2635	532.6062	90.9072	87.7686	1.1651	1.1934
6	3059.7105	1.0838	3.8088	3010.7074	0.1142	0.3917	0.1177	0.2306	0.1198	0.4112	1.0335	4.2627	1.0586	4.2193	547.3161	31.2426	31.2426	547.3161	0.2640	532.4705	91.0802	87.4766	1.1591	1.1872
7	3051.6027	1.0533	3.4487	3002.4369	0.1060	0.3647	0.1104	0.2171	0.1104	0.3801	0.9618	3.7678	0.9849	3.7278	546.7249	31.1825	31.1825	546.7249	0.2446	533.9494	84.4919	76.8103	1.0970	1.1233
8	3066.4504	1.0606	3.5256	3017.0503	0.1065	0.3663	0.1108	0.2178	0.1108	0.3817	0.9659	3.7063	0.9890	3.6667	546.8684	31.1951	31.1951	546.8684	0.2456	533.9829	84.8545	74.7860	1.0635	1.0890
9	3066.2310	0.5699	1.6586	3016.2889	0.0878	0.3035	0.0968	0.1914	0.0923	0.3194	0.8143	2.8771	0.8334	2.8440	545.8156	31.0343	31.0343	545.8156	0.2061	536.6985	71.3761	55.8191	0.9435	0.9656
10	3062.1466	0.5269	1.5324	3012.3721	0.0886	0.3063	0.0971	0.1919	0.0919	0.3179	0.8161	2.8238	0.8352	2.7913	545.7778	31.0411	31.0411	545.7778	0.2064	536.6305	71.4942	54.8895	0.9263	0.9480
11	3066.4504	0.8395	2.2307	3015.3625	0.0740	0.2563	0.0857	0.1698	0.0774	0.2683	0.6944	2.3349	0.7106	2.3060	545.4725	30.9014	30.9014	545.4725	0.1757	538.8179	60.9795	42.3435	0.8374	0.8570
12	3059.5234	0.8399	2.2138	3008.2115	0.0741	0.2565	0.0856	0.1695	0.0772	0.2675	0.6936	2.2474	0.7098	2.2193	545.5306	30.9016	30.9016	545.5306	0.1755	538.8926	60.9036	41.0310	0.8124	0.8315
13	3063.0845	0.9453	2.2234	3011.8582	0.0531	0.1840	0.0646	0.1281	0.0627	0.2176	0.5296	1.7225	0.5417	1.7001	544.6530	30.7144	30.7144	544.6530	0.1345	540.7402	46.7596	26.9566	0.6952	0.7111
14	3053.4355	0.5137	1.2315	3002.5178	0.0524	0.1815	0.0643	0.1274	0.0624	0.2163	0.5252	1.7226	0.5371	1.7003	544.7445	30.7080	30.7080	544.7445	0.1335	540.8879	46.4226	26.2329	0.6815	0.6970
15	3055.1924	0.5307	1.1600	3003.2830	0.0401	0.1388	0.0460	0.0910	0.0396	0.1370	0.3668	1.3906	0.3752	1.3717	544.4334	30.4827	30.4827	544.4334	0.0929	542.5623	32.3353	16.2176	0.6047	0.6185
16	3059.3986	0.5674	1.2403	3007.1695	0.0403	0.1395	0.0460	0.0909	0.0396	0.1370	0.3674	1.3087	0.3758	1.2908	544.5252	30.4887	30.4887	544.5252	0.0930	542.6491	32.3783	15.2772	0.5688	0.5818
1	4075.7552	1.2583	8.0856	4009.7836	0.1653	0.5644	0.1686	0.3287	0.1684	0.5761	1.4692	10.0437	1.5115	9.9819	556.2035	32.5308	32.5308	556.2035	0.3793	525.9303	130.0632	160.6871	1.4907	1.5336
2	4077.1956	1.3636	8.8568	4011.6702	0.1651	0.5635	0.1674	0.3263	0.1689	0.5779	1.4677	10.1770	1.5098	10.1155	556.3044	32.5254	32.5254	556.3044	0.3790	526.0757	129.9676	160.8117	1.4931	1.5359
3	4054.9862	1.2919	8.4014	3990.5365	0.1639	0.5597	0.1680	0.3278	0.1676	0.5735	1.4610	10.2985	1.5026	10.2380	556.1767	32.5160	32.5160	556.1767	0.3770	526.2544	129.3073	161.3622	1.5062	1.5490
4	4074.4821	1.2583	8.2475	4009.6634	0.1641	0.5603	0.1676	0.3270	0.1681	0.5754	1.4628	10.3255	1.5045	10.2650	556.3447	32.5241	32.5241	556.3447	0.3775	526.3372	129.4914	160.7582	1.4984	1.5411
5	4068.7903	1.1941	7.4867	4002.9936	0.1552	0.5329	0.1591	0.3121	0.1575	0.5414	1.3864	9.5431	1.4255	9.4794	555.7860	32.4154	32.4154	555.7860	0.3554	529.0525	122.2232	146.6021	1.4473	1.4881
6	4061.3815	1.2605	7.8464	3995.0181	0.1546	0.5309	0.1593	0.3124	0.1581	0.5436	1.3869	9.4171	1.4263	9.3529	555.8406	32.4191	32.4191	555.8406	0.3556	529.0796	122.2861	145.7423	1.4378	1.4787
7	4087.0825	0.9743	5.8206	4020.1116	0.1424	0.4919	0.1481	0.2925	0.1454	0.5028	1.2872	8.5485	1.3229	8.4838	555.1475	32.2947	32.2947	555.1475	0.3274	532.3208	112.9398	127.3273	1.3600	1.3978
8	4073.4310	1.0746	6.3650	4006.5495	0.1421	0.4911	0.1483	0.2929	0.1453	0.5028	1.2868	8.4261	1.3226	8.3622	555.0341	32.2966	32.2966	555.0341	0.3273	532.2311	112.8810	126.4872	1.3517	1.3893
9	4067.9075	0.9073	4.7956	4000.6029	0.1198	0.4174	0.1308	0.2607	0.1220	0.4253	1.1034	6.6684	1.1330	6.6100	553.2693	32.0358	32.0358	553.2693	0.2779	536.6855	96.2649	95.6595	1.1986	1.2308
10	4060.6394	0.8525	4.5024	3993.2689	0.1197	0.4170	0.1315	0.2620	0.1212	0.4222	1.1012	6.6074	1.1307	6.5487	553.3019	32.0292	32.0292	553.3019	0.2775	536.7659	96.1260	94.7609	1.1890	1.2209
11	4066.8873	0.9678	4.6546	3997.5828	0.1046	0.3655	0.1198	0.2396	0.1047	0.3660	0.9711	5.4728	0.9970	5.4183	552.3852	31.8371	31.8371	552.3852	0.2443	539.5079	84.8277	76.0364	1.0806	1.1094
12	4072.5738	0.8903	4.3084	4002.8585	0.1035	0.3617	0.1196	0.2392	0.1053	0.3680	0.9689	5.4280	0.9947	5.3732	552.5700	31.8317	31.8317	552.5700	0.2438	539.7387	84.6763	74.7667	1.0644	1.0928
13	4057.5912	0.7805	3.1756	3987.9010	0.0693	0.2429	0.0847	0.1697	0.0805	0.2823	0.6948	3.5647	0.7126	3.5244	550.3574	31.3875	31.3875	550.3574	0.1748	543.7147	60.9253	41.8935	0.8288	0.8500
14	4071.5790	0.6801	2.7661	4001.6682	0.0688	0.2410	0.0844	0.1690	0.0801	0.2807	0.6907	3.4810	0.7083	3.4415	550.3484	31.3791	31.3791	550.3484	0.1738	543.7779	60.5932	40.7002	0.8097	0.8303
15	4089.4781	0.7024	2.6222	4018.5117	0.0557	0.1946	0.0625	0.1246	0.0522	0.1822	0.5014	2.6260	0.5141	2.5944	549.5144	31.0104	31.0104	549.5144	0.1261	546.0430	44.0431	24.3736	0.6669	0.6837
16	4089.3667	0.6268	2.3432	4017.9824	0.0558	0.1950	0.0624	0.1245	0.0514	0.1792	0.4987	2.4582	0.5112	2.4282	549.6440	31.0105	31.0105	549.6440	0.1255	546.2010	43.8624	22.6899	0.6234	0.6391
1	5102.5188	1.6087	16.5327	5023.3782	0.2057	0.7038	0.2101	0.4108	0.2059	0.7063	1.8210	19.8787	1.8774	19.8263	567.0748	34.2152	34.2152	567.0748	0.4726	520.5692	161.2047	245.2570	1.8370	1.8940
2	5098.8766	1.5268	15.8655	5018.5875	0.2058	0.7040	0.2101	0.4105	0.2060	0.7059	1.8204	20.2195	1.8774	20.1617	567.6997	34.2151	34.2151	567.6997	0.4728	521.1131	161.3452	246.7364	1.8460	1.9038
3	5087.3338	1.6255	16.5772	5008.1208	0.2038	0.6978	0.2086	0.4081	0.2047	0.7026	1.8085	19.7841	1.8646	19.7290	566.8921	34.1700	34.1700	566.8921	0.4690	521.0492	160.0520	244.3322	1.8431	1.9002
4	5062.8223	1.8544	18.9212	4984.2401	0.2034	0.6960	0.2088	0.4085	0.2054	0.7049	1.8094	19.7941	1.8654	19.7406	566.8653	34.1720	34.1720	566.8653	0.4693	520.9766	160.1320	244.3572	1.8425	1.8995
5	5089.7935	1.6586	16.3255	5009.2453	0.1938	0.6688	0.1992	0.3927	0.1936	0.6690	1.7305	18.4350	1.7834	18.3669	566.1214	34.0376	34.0376	566.1214	0.4445	524.6636	152.2050	224.3306	1.7790	1.8334
6	5072.5807	1.5719	15.5364	4992.7670	0.1933	0.6670	0.1991	0.3927	0.1935	0.6687	1.7284	18.4220	1.7811	18.3552	566.1670	34.0321	34.0321	566.1670	0.4439	524.8023	152.0339	222.8336	1.7693	1.8232
7	5073.0960	1.2462	10.4660	4989.4500	0.1527	0.5390	0.1663	0.3360	0.1506	0.5310	1.4060	13.0014	1.4462	12.9112	562.5726	33.4729	33.4729	562.5726	0.3515	536.0793	121.6727	148.2124	1.4693	1.5114
8	5099.6999	1.1960	10.1042	5015.4758	0.1522	0.5370	0.1655	0.3342	0.1493	0.5262	1.3974	12.8488	1.4373	12.7583	562.7539	33.4354	33.4354	562.7539	0.3496	536.5294	121.0539	144.8709	1.4435	1.4847
9	5081.9471	1.1465	8.6409	4996.2634	0.1270	0.4508	0.1474	0.2998	0.1255	0.4453	1.1958	9.9963	1.2288	9.9092	560.4023	33.0360	33.0360	560.4023	0.2976	541.2282	103.5101	108.0921	1.2591	1.2938
10	5091.6073	1.0490	7.9012	5004.9672	0.1274	0.4522	0.1474	0.2998	0.1257	0.4456	1.1977	9.8877	1.2308	9.7998	560.5682	33.0393	33.0393	560.5682	0.2981	541.3286	103.6867	107.1241	1.2455	1.2800
11	5106.4273	0.7112	4.6139	5020.0067	0.0883	0.3146	0.1090	0.2222	0.1005	0.3585	0.8953	6.4777	0.9185	6.4103	557.3674	32.4366	32.4366	557.3674	0.2218	546.6122	77.5239	60.8614	0.9465	0.9711
12	5110.7334	0.8830	5.7507	5024.4329	0.0881	0.3140	0.1094	0.2231	0.1024	0.3654	0.9026	6.3253	0.9259	6.2595	557.3825	32.4633	32.4633	557.3825	0.2238	546.4373	78.2056	59.7821	0.9217	0.9455
13	5075.6708	0.7415	4.2851	4987.5620	0.0727	0.2578	0.0806	0.1630	0.0644	0.2277	0.6485	4.4482	0.6650	4.3959	555.6899	31.8023	31.8023	555.6899	0.1615	549.9509	56.6296	34.3246	0.7305	0.7491
14	5078.5920	0.8266	4.7683	4989.6504	0.0730	0.2586	0.0801	0.1620	0.0628	0.2220	0.6426	4.3429	0.6591	4.2911	555.8359	31.8040	31.8040	555.8359	0.1604	550.1721	56.2576	33.3355	0.7140	0.7323
15	5105.5147	1.2172	9.8628	5019.2121	0.1427	0.5048	0.1594	0.3231	0.1406	0.4968	1.3248	11.8357	1.3625	11.7424	562.1689	33.3058	33.3058	562.1689	0.3305	538.6313	114.6851	131.7085	1.3847	1.4242
16	5094.3310	1.2268	9.8927	5008.9830	0.1424	0.5042	0.1594	0.3231	0.1406	0.4970	1.3243	11.6517	1.3618	11.5612	561.8733	33.3088	33.3088	561.8733	0.3303	538.3811	114.5743	130.2406	1.3708	1.4096
1	6112.1901	2.0268	30.1398	6019.5604	0.2416	0.8298	0.2447	0.4798	0.2417	0.8328	2.1425	34.1241	2.2154	34.1583	580.4704	36.2418	36.2418	580.4704	0.5586	516.0675	189.7048	341.4010	2.1737	2.2477
2	6108.5497	1.6843	25.1442	6017.0314	0.2414	0.8295	0.2449	0.4803	0.2415	0.8317	2.1415	33.9979	2.2136	34.0318	580.4707	36.2367	36.2367	580.4707	0.5583	516.1232	189.6232	338.6257	2.1573	2.2300
3	6117.7989	1.9100	28.4349	6026.2014	0.2411	0.8294	0.2440	0.4790	0.2415	0.8333	2.1417	34.0069	2.2140	34.0436	580.3257	36.2666	36.2666	580.3257	0.5575	516.1471	189.3742	339.2613	2.1643	2.2373
4	6121.9189	1.9945	29.6123	6031.7098	0.2408	0.8283	0.2439	0.4789	0.2411	0.8317	2.1389	33.6952	2.2105	33.7381	579.9474	36.2444	36.2444	579.9474	0.5567	515.9851	189.0546	336.5104	2.1509	2.2228
5	6107.4616	1.7545	25.1451	6015.1601	0.2264	0.7883	0.2331	0.4635	0.2262	0.7884	2.0402	31.2001	2.1073	31.1980	578.8097	36.0056	36.0056	578.8097	0.5233	521.6651	178.6952	305.4039	2.0644	2.1322
6	6114.4011	1.8372	26.3149	6023.4870	0.2259	0.7866	0.2329	0.4632	0.2261	0.7889	2.0387	30.9817	2.1049	30.9831	578.4751	35.9982	35.9982	578.4751	0.5227	521.4872	178.4500	303.3790	2.0540	2.1207
7	6104.1995	1.8035	24.4385	6011.5036	0.2090	0.7365	0.2195	0.4425	0.2103	0.7420	1.9210	27.8187	1.9816	27.7771	576.5635	35.7279	35.7279	576.5635	0.4850	526.9836	166.4479	268.4931	1.9483	2.0097
8	6121.3567	1.3034	17.7184	6026.1570	0.2089	0.7360	0.2198	0.4431	0.2083	0.7343	1.9134	27.9337	1.9745	27.8822	577.1022	35.6972	35.6972	577.1022	0.4833	527.7822	166.0112	267.9695	1.9489	2.0111
9	6112.2211	1.5610	19.1852	6012.9223	0.1795	0.6442	0.1946	0.3998	0.1751	0.6274	1.6714	22.1278	1.7223	22.0248	574.0196	35.1572	35.1572	574.0196	0.4132	537.3318	143.1812	202.5001	1.7064	1.7584
10	6112.7506	1.5367	18.7080	6013.5121	0.1787	0.6413	0.1942	0.3991	0.1744	0.6250	1.6654	21.8520	1.7160	21.7491	573.6583	35.1294	35.1294	573.6583	0.4116	537.2454	142.6438	201.1358	1.7013	1.7530
11	6103.7959	1.4234	15.7364	6000.6577	0.1553	0.5618	0.1779	0.3689	0.1513	0.5464	1.4771	17.6131	1.5205	17.4892	571.0164	34.6912	34.6912	571.0164	0.3622	542.5385	126.1476	158.1268	1.5114	1.5558
12	6105.0690	1.4593	16.0584	6002.0270	0.1546	0.5595	0.1775	0.3682	0.1504	0.5430	1.4707	17.5728	1.5138	17.4491	570.8473	34.6676	34.6676	570.8473	0.3608	542.5989	125.6386	157.8335	1.5147	1.5591
13	6106.1253	0.9098	8.4775	6003.2716	0.1012	0.3672	0.1292	0.2686	0.1146	0.4165	1.0523	11.1166	1.0803	11.0091	565.8418	33.5932	33.5932	565.8418	0.2571	551.2696	90.2376	84.5831	1.1302	1.1602
14	6120.3265	0.9058	8.4179	6017.0713	0.1026	0.3726	0.1301	0.2707	0.1156	0.4205	1.0638	10.9376	1.0920	10.8315	565.7950	33.6301	33.6301	565.7950	0.2596	550.9470	91.0876	84.2319	1.1150	1.1446
15	6124.9183	0.7281	6.1309	6016.1941	0.0881	0.3180	0.0968	0.1994	0.0782	0.2814	0.7988	7.7391	0.8198	7.6482	564.1256	32.8209	32.8209	564.1256	0.1955	555.6334	68.8864	49.7917	0.8707	0.8936
16	6120.6388	0.6263	5.2451	6010.6422	0.0882	0.3184	0.0961	0.1980	0.0784	0.2820	0.7984	7.5242	0.8195	7.4340	564.2404	32.8217	32.8217	564.2404	0.1952	555.7685	68.8042	48.5945	0.8506	0.8732

APPENDIX B. CROSSFLOW FAN GRID GENERATION CODE

B1. GRID GENERATION FLO++ INPUT CODE

```
// MESHDEMO
// Pre processing
// Demonstrating different meshing techniques

reset

// *** crossflowfan : Flo++ input file
// *** Insert your Flo++ code here
reset
csys 0
#def span 1.5
#def spnblk 1
#def chordblk 30
#def cbr 1.2
#def cscblk 20
#def cscr 1.2
#def clnc 6.13
// *** Mesh generation ****************************
// *** (Template for flow between parallel plates)

////Build fan passage splines/////////////////////
//vread c:\vread15mod.txt 0 ALL
wall yes
vread d:\nps\thesis\vread15mod_cheng.txt 0 ALL
vp
vset news vlist 338 339
vmerge vset 0.0001
vset news vlist 111 112
vmerge vset 0.0001
vset news vlist 211 212

vmax

spline 1 vran vmax - 436 vmax - 325 1
#def bp1 vmax - 378
splmodify 1 modify bp1 -bp1
spline 2 vran vmax - 325 vmax - 225 1
#def bp2 vmax - 277
splmodify 2 modify bp2 -bp2
spline 3 vran vmax - 225 vmax - 99 1
#def bp3 vmax - 162
splmodify 3 modify bp3 -bp3
spline 4 vlist vmax - 99 vmax - 89 vmax - 79 vmax - 69 vmax - 59 vmax - 49 vmax - 39 vmax - 29 vmax - 19 vmax - 9
vmax - 436
#def bp4 vmax - 49
splmodify 4 modify bp4 -bp4
sp

vset all
vcopy 2 vmax vset span 0 0
vp

spline 5 vran vmax - 436 vmax - 325 1
#def bp5 vmax - 378
splmodify 5 modify bp5 -bp5
spline 6 vran vmax - 325 vmax - 225
```

```
#def bp6 vmax - 277
splmodify 6 modify bp6 -bp6
spline 7 vran vmax - 225 vmax - 99 1
#def bp7 vmax - 162
splmodify 7 modify bp7 -bp7
spline 8 vlist vmax - 99 vmax - 89 vmax - 79 vmax - 69 vmax - 59 vmax - 49 vmax - 39 vmax - 29 vmax - 19 vmax - 9
vmax - 436
#def bp8 vmax - 49
splmodify 8 modify bp8 -bp8
sp

vmax

/////Build fan passage block//////////////////////
cgro 1
block 1 vmax - 873 vmax - 762 vmax - 662 vmax - 536 vmax - 436 vmax - 325 vmax - 225 vmax - 99
blplot
blfactors 1 chordblk cscblk spnblk 1
blcd 1 1 chordblk / 2 cbr chordblk / 2 1 / cbr
blcd 1 2 chordblk / 2 cbr chordblk / 2 1 / cbr
blcd 1 3 chordblk / 2 cbr chordblk / 2 1 / cbr
blcd 1 4 chordblk / 2 cbr chordblk / 2 1 / cbr
blcd 1 5 cscblk / 2 cscr cscblk / 2 1 / cscr
blcd 1 6 cscblk / 2 cscr cscblk / 2 1 / cscr
blcd 1 7 cscblk / 2 cscr cscblk / 2 1 / cscr
blcd 1 8 cscblk / 2 cscr cscblk / 2 1 / cscr

blex 1
view 1 0 0
cp

local 2 cyli 0 0 0 0 90 0 0
csys 2
mcrea 4.15 4.2 2 77.97949 84.18 10 0 span spnblk 1 cscr 1
mcrea 4.15 4.2 2 84.18 90 10 0 span spnblk 1 1 / cscr 1

cp
mcrea 6 6.1 3 88.2039 94.1432 10 0 span spnblk 1.5 cscr 1
mcrea 6 6.1 3 94.1432 100.2038 10 0 span spnblk 1.5 1 / cscr 1
cp
save 12

resu 12

spldelete all
bldelete all
cset news cgro 1
vset news cset
vset unsel
vdel vset
vset all
cp
vcdist all
// VCDIST tell us that we should not merge closer than aprox 0.002181
vmerge all 0.002
vcomp all
vcdist all
cp

/////Copy fan passage and build complete fan///////
cset news cgro 1
local 2 cyli 0 0 0 0 90 0 0
```

```
csys 2
cgro 2
// Louis: Copy in 1 action
mcopy 30 vmax 0 12 0 active
vcdist all
vmerge all 0.0015
vcomp all
vcdist all

cset all
cgro 0
cgmodify all

save 13

resu 13

/////Build fan clearance layer////////////////////
csys 2
cgro 2
mcrea 6.1 clnc 3 0 360 360 0 span spnblk 1 1 1

/////Build Intake////////////////////////////////////////////////////////////
/////Intake First Block////////////////


csys 3

spldelete all
v vmax + 1 0 4.8676 3.726
v vmax + 1 0 4.8852 3.7369
v vmax + 1 0 4.9001 3.7228
v vmax + 1 0 4.9211 3.7142
v vmax + 1 0 4.9415 3.7136
v vmax + 1 0 4.9571 3.7183

csys 2

v vmax + 1 6.1967 125 0
v vmax + 1 6.1967 120 0
v vmax + 1 6.1967 115 0
v vmax + 1 6.1967 110 0
v vmax + 1 6.1967 105 0
v vmax + 1 6.1967 100 0
v vmax + 1 6.1967 95 0
v vmax + 1 6.1967 90 0
v vmax + 1 6.1967 85 0
v vmax + 1 6.1967 80 0
v vmax + 1 6.1967 75 0
v vmax + 1 6.1967 70 0
v vmax + 1 6.1967 65 0
v vmax + 1 6.1967 60 0
v vmax + 1 6.1967 55 0
v vmax + 1 6.1967 50 0
v vmax + 1 6.1967 45 0
v vmax + 1 6.1967 40 0
v vmax + 1 6.1967 35 0
v vmax + 1 6.1967 30 0
v vmax + 1 6.1967 25 0

csys 3
```

```
v vmax + 1 0 2.4157 -5.6827
v vmax + 1 0 2.4057 -5.6731
v vmax + 1 0 2.3921 -5.6666
v vmax + 1 0 2.3789 -5.6648
v vmax + 1 0 2.3645 -5.6673
v vmax + 1 0 2.3603 -5.6574

csys 2

v vmax + 1 clnc 25 0
v vmax + 1 clnc 30 0
v vmax + 1 clnc 35 0
v vmax + 1 clnc 40 0
v vmax + 1 clnc 45 0
v vmax + 1 clnc 50 0
v vmax + 1 clnc 55 0
v vmax + 1 clnc 60 0
v vmax + 1 clnc 65 0
v vmax + 1 clnc 70 0
v vmax + 1 clnc 75 0
v vmax + 1 clnc 80 0
v vmax + 1 clnc 85 0
v vmax + 1 clnc 90 0
v vmax + 1 clnc 95 0
v vmax + 1 clnc 100 0
v vmax + 1 clnc 105 0
v vmax + 1 clnc 110 0
v vmax + 1 clnc 115 0
v vmax + 1 clnc 120 0
v vmax + 1 clnc 125 0

vmax
vp

spldelete all
#def bp1 vmax - 52
spline 1 vlist vmax - 53 -bp1 vmax - 51 vmax - 50 vmax - 49 vmax - 48
spline 2 vran vmax - 48 vmax - 26 1
#def bp3 vmax - 22
spline 3 vlist  vmax - 26 vmax - 25 vmax - 24 vmax - 23 -bp3 vmax - 21
        spline 4 vlist vmax - 21 vmax - 20 vmax - 19 vmax - 18 vmax - 17 vmax - 16 vmax - 15 vmax - 14 vmax - 13
        vmax - 12 vmax - 11 vmax - 10 vmax - 9 vmax - 8 vmax - 7 vmax - 6 vmax - 5 vmax - 4 vmax - 3 vmax - 2
        vmax - 1 vmax vmax - 53
sp

csys 3
vcopy 2 54 vran vmax - 53 vmax 1 span 0 0
vp

#def bp5 vmax - 52
spline 5 vlist vmax - 53 -bp5 vmax - 51 vmax - 50 vmax - 49 vmax - 48
spline 6 vran vmax - 48 vmax - 26 1
#def bp7 vmax - 22
spline 7 vlist  vmax - 26 vmax - 25 vmax - 24 vmax - 23 -bp7 vmax - 21
        spline 8 vlist vmax - 21 vmax - 20 vmax - 19 vmax - 18 vmax - 17 vmax - 16 vmax - 15 vmax - 14 vmax - 13
        vmax - 12 vmax - 11 vmax - 10 vmax - 9 vmax - 8 vmax - 7 vmax - 6 vmax - 5 vmax - 4 vmax - 3 vmax - 2
        vmax - 1 vmax vmax - 53
sp
vmax

bldelete all
block 9 vmax - 48 vmax - 26 vmax - 21 vmax - 53 vmax - 102 vmax - 80 vmax - 75 vmax - 107
```

```
blfactors 9 50 5 spnblk 3

blex 9


/////Intake Second Block////////////////////////////
vset none

csys 3
v vmax + 1 0 4.9571 3.7183
v vmax + 1 0 5.0204 3.7809
v vmax + 1 0 5.0811 3.8448
v vmax + 1 0 5.1426 3.9136
v vmax + 1 0 5.2094 3.9943
v vmax + 1 0 5.4164 4.2939
v vmax + 1 0 5.6144 4.6854
v vmax + 1 0 5.7769 5.1999
v vmax + 1 0 5.8362 5.7068
v vmax + 1 0 5.7902 6.2869
v vmax + 1 0 5.6351 6.9151
v vmax + 1 0 5.2369 7.9234
v vmax + 1 0 3.35 11.56
v vmax + 1 0 -3.007 23.8109////
//v vmax + 1 0 9.16 6.56 //Adjusted point from z=11.56
//v vmax + 1 0 11.16 2 //Added to adjust grid
//v vmax + 1 0 11.16 -6.56 //Added for smoothness
csys 2
v vmax + 1 24 180 0
v vmax + 1 24 170 0
v vmax + 1 24 160 0
v vmax + 1 24 150 0
v vmax + 1 24 140 0
v vmax + 1 24 130 0
v vmax + 1 24 120 0
v vmax + 1 24 110 0
v vmax + 1 24 100 0
v vmax + 1 24 90 0
v vmax + 1 24 80 0
v vmax + 1 24 70 0
v vmax + 1 24 60 0

csys 3
v vmax + 1 0 19.3968 -14.1337////
v vmax + 1 0 9.16 -11.05
v vmax + 1 0 7.07 -10.42
v vmax + 1 0 4.26 -8.21
v vmax + 1 0 2.78 -6.41
v vmax + 1 0 2.53 -6.00 //added for continuity
v vmax + 1 0 2.4157 -5.6827

csys 2

v vmax + 1 6.1967 125 0
v vmax + 1 6.1967 120 0
v vmax + 1 6.1967 115 0
v vmax + 1 6.1967 110 0
v vmax + 1 6.1967 105 0
v vmax + 1 6.1967 100 0
v vmax + 1 6.1967 95 0
v vmax + 1 6.1967 90 0
v vmax + 1 6.1967 85 0
v vmax + 1 6.1967 80 0
```

```
v vmax + 1 6.1967 75 0
v vmax + 1 6.1967 70 0
v vmax + 1 6.1967 65 0
v vmax + 1 6.1967 60 0
v vmax + 1 6.1967 55 0
v vmax + 1 6.1967 50 0
v vmax + 1 6.1967 45 0
v vmax + 1 6.1967 40 0
v vmax + 1 6.1967 35 0
v vmax + 1 6.1967 30 0
v vmax + 1 6.1967 25 0
vp
vmax



spldelete all
spline 1 vran vmax - 54 vmax - 41 1
spline 2 vran vmax - 41 vmax - 27 1
spline 3 vran vmax - 27 vmax - 21 1
spline 4 vlist vmax - 21 vmax vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8 vmax - 9
vmax - 10
spline 4 vlist vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax - 16 vmax - 17 vmax - 18 vmax - 19 vmax -
20 vmax - 54
sp
csys 3
vcopy 2 55 vran vmax - 54 vmax 1 span 0 0
vp

spline 5 vran vmax - 54 vmax - 41 1
spline 6 vran vmax - 41 vmax - 27 1
spline 7 vran vmax - 27 vmax - 21 1
spline 8 vlist vmax - 21 vmax vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8 vmax - 9
vmax - 10
spline 8 vlist vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax - 16 vmax - 17 vmax - 18 vmax - 19 vmax -
20 vmax - 54
sp
vmax
bldelete all
block 10 vmax - 54 vmax - 41 vmax - 27 vmax - 21 vmax - 109 vmax - 96 vmax - 82 vmax - 76
blfactors 10 20 50 spnblk 4
blcd 10 1 20 1.1
blcd 10 4 20 1.1
blcd 10 2 20 1 / 1.1
blcd 10 3 20 1 / 1.1
blex 10

cset news cgro 4
cp
cset cgro 3

#def cm1 12310
/////Build inner fan mesh////////////////////////
#def vm1 vmax
cgro 1
csys 2
v vmax + 1 3 135 0
v vmax + 1 4.15 135 0
v vmax + 1 4.15 125 0
v vmax + 1 4.15 115 0
v vmax + 1 4.15 105 0
v vmax + 1 4.15 95 0
```

```
v vmax + 1 4.15 85 0
v vmax + 1 4.15 75 0
v vmax + 1 4.15 65 0
v vmax + 1 4.15 55 0
v vmax + 1 4.15 45 0
v vmax + 1 3 45 0
vp
spline 9 vlist vmax - 11 vmax - 10
spline 10 vran vmax - 10 vmax - 1 1
spline 11 vlist vmax - 1 vmax
spline 12 vlist vmax vmax - 11
sp
vset none
vset news vran vmax - 11 vmax 1
vcopy 2 12 vset 0 0 span
vp

spline 13 vlist vmax - 11 vmax - 10
spline 14 vran vmax - 10 vmax - 1 1
spline 15 vlist vmax - 1 vmax
spline 16 vlist vmax vmax - 11
sp
block 2 vmax - 23 vmax - 22 vmax - 10 vmax - 11 vmax - 12 vmax - 13 vmax - 1 vmax
blplot
blfactors 2 10 spnblk 30 1
blcd 2 1 10 1 / 1.4
blcd 2 2 10 1 / 1.4
blcd 2 3 10 1.4
blcd 2 4 10 1.4

blex 2

cset cgro 1

view 1 0 0

vset news cset
vp
cset news cgro 1


#def vm2 vmax - vm1

mcopy 4 vm2 0 90 0 active
cset news cgro 1
cp

/////Build inner fan mesh center block/////////////
vmax
csys 0
cgro 1
mcrea 0 span spnblk -2.12132 2.12132 30 -2.12132 2.12132 30 1 1 1
cset cgro 1
cp


vset news cset
vp
vmerge vset
csys 0
/////Build LP cavity/////////////////////////
/////LP First Block///////////////
```

```
vset none
vset news
csys 3
v vmax + 1 0 2.3603 -5.6574
v vmax + 1 0 2.3645 -5.6673
v vmax + 1 0 2.3516 -5.6744
v vmax + 1 0 2.3407 -5.6866
v vmax + 1 0 2.3344 -5.7035
v vmax + 1 0 2.3351 -5.7205
vp
csys 2
v vmax + 1 6.1787 20 0
v vmax + 1 6.1787 15 0
v vmax + 1 6.1787 10 0
v vmax + 1 6.1787 5 0
v vmax + 1 6.1787 0 0
v vmax + 1 6.1787 -5 0
v vmax + 1 6.1787 -10 0
v vmax + 1 6.1787 -15 0
v vmax + 1 6.1787 -20 0
v vmax + 1 6.1787 -25 0
v vmax + 1 6.1787 -30 0
v vmax + 1 6.1787 -35 0
v vmax + 1 6.1787 -40 0
v vmax + 1 6.1787 -45 0
v vmax + 1 6.1787 -50 0
vp
csys 3
v vmax + 1 0 -4.8676 -3.8054
v vmax + 1 0 -4.8818 -3.7668
v vmax + 1 0 -4.8459 -3.7542
vp
csys 2
v vmax + 1 clnc -50 0
v vmax + 1 clnc -45 0
v vmax + 1 clnc -40 0
v vmax + 1 clnc -35 0
v vmax + 1 clnc -30 0
v vmax + 1 clnc -25 0
v vmax + 1 clnc -20 0
v vmax + 1 clnc -15 0
v vmax + 1 clnc -10 0
v vmax + 1 clnc -5 0
v vmax + 1 clnc 0 0
v vmax + 1 clnc 5 0
v vmax + 1 clnc 10 0
v vmax + 1 clnc 15 0
v vmax + 1 clnc 20 0
vp

vmax
spldelete all
#def bp1 vmax - 37
spline 1 vlist vmax - 38 -bp1 vmax - 36 vmax - 35 vmax - 34 vmax - 33
spline 2 vran vmax - 33 vmax - 17 1
#def bp3 vmax - 16
spline 3 vlist vmax - 17 -bp3 vmax - 15
spline 4 vlist vmax - 15 vmax - 14 vmax - 13 vmax - 12 vmax - 11 vmax - 10 vmax - 9 vmax - 8 vmax - 7 vmax - 6
vmax - 5 vmax - 4 vmax - 3 vmax - 2 vmax - 1 vmax vmax - 38
sp

vcopy 2 39 vset 0 0 span
```

```
vp
#def bp5 vmax - 37
spline 5 vlist vmax - 38 -bp5 vmax - 36 vmax - 35 vmax - 34 vmax - 33
spline 6 vran vmax - 33 vmax - 17 1
#def bp7 vmax - 16
spline 7 vlist vmax - 17 -bp7 vmax - 15
spline 8 vlist vmax - 15 vmax - 14 vmax - 13 vmax - 12 vmax - 11 vmax - 10 vmax - 9 vmax - 8 vmax - 7 vmax - 6
vmax - 5 vmax - 4 vmax - 3 vmax - 2 vmax - 1 vmax vmax - 38
sp

vmax
bldelete all
block 11 vmax - 38 vmax - 33 vmax - 17 vmax - 15 vmax - 77 vmax - 72 vmax - 56 vmax - 54
blplot
blfactors 11 5 30 spnblk 5
blex 11


/////LP Second Block////////////////////

vset news none

csys 3
v vmax + 1 0 2.3351 -5.7205
v vmax + 1 0 2.3576 -5.8582
v vmax + 1 0 2.3791 -6.0989
v vmax + 1 0 2.3753 -6.3741
v vmax + 1 0 2.3418 -6.649
v vmax + 1 0 2.2034 -7.0359
v vmax + 1 0 1.8774 -7.4162
v vmax + 1 0 1.4134 -7.7727
v vmax + 1 0 .4909 -7.9588
v vmax + 1 0 -.2726 -7.9034
v vmax + 1 0 -1.2811 -7.5651
v vmax + 1 0 -2.0786 -7.1576
v vmax + 1 0 -2.8812 -6.5783
v vmax + 1 0 -3.5716 -5.8094
v vmax + 1 0 -4.21 -4.9431
v vmax + 1 0 -4.6805 -4.188
v vmax + 1 0 -4.8676 -3.8054
v vmax + 1 0 -4.8676 -3.8054

csys 2

v vmax + 1 6.1787 20 0
v vmax + 1 6.1787 15 0
v vmax + 1 6.1787 10 0
v vmax + 1 6.1787 5 0
v vmax + 1 6.1787 0 0
v vmax + 1 6.1787 -5 0
v vmax + 1 6.1787 -10 0
v vmax + 1 6.1787 -15 0
v vmax + 1 6.1787 -20 0
v vmax + 1 6.1787 -25 0
v vmax + 1 6.1787 -30 0
v vmax + 1 6.1787 -35 0
v vmax + 1 6.1787 -40 0
v vmax + 1 6.1787 -45 0
v vmax + 1 6.1787 -50 0

csys 3
v vmax + 1 0 2.3351 -5.7205
```

```
vmax
vp
spldelete all
spline 1 vran vmax - 33 vmax - 17 1
spline 2 vlist vmax - 16 vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8 vmax - 9 vmax - 10
vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax
sp

csys 2

vcopy 2 34 vset 0 0 span
vp
vmax
spline 3 vran vmax - 33 vmax - 17 1
spline 4 vlist vmax - 16 vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8 vmax - 9 vmax - 10
vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax
sp

bldelete all
block 12 vmax - 33 vmax - 17 vmax - 16 vmax vmax - 67 vmax - 51 vmax - 50 vmax - 34
blfactors 12 30 10 spnblk 6
blcd 12 1 30 1 / 1.01
blcd 12 4 30 1 / 1.01
blex 12
cset news cgro 6
cp
/////Build Exhaust Wall///////////////////////////////////////////////////////////
/////First Block//////////////////
save 22

resu 22
vset none

cset news
cgro 4
vset none
#def vmo vmax

csys 3
v vmax + 1 0 -4.8459 -3.7542
v vmax + 1 0 -4.8818 -3.7668
v vmax + 1 0 -4.8863 -3.7626
v vmax + 1 0 -4.9088 -3.7547
v vmax + 1 0 -4.9347 -3.7653
v vmax + 1 0 -4.9454 -3.7909
vp
csys 2
v vmax + 1 6.2312 305 0
v vmax + 1 6.2312 300 0
v vmax + 1 6.2312 295 0
v vmax + 1 6.2312 290 0
v vmax + 1 6.2312 285 0
v vmax + 1 6.2312 280 0
v vmax + 1 6.2312 275 0
v vmax + 1 6.2312 270 0
v vmax + 1 6.2312 265 0
v vmax + 1 6.2312 260 0
v vmax + 1 6.2312 255 0
v vmax + 1 6.2312 250 0
v vmax + 1 6.2312 245 0
v vmax + 1 6.2312 240 0
v vmax + 1 6.2312 235 0
```

```
v vmax + 1 6.2312 230 0
v vmax + 1 6.2312 225 0
v vmax + 1 6.2312 220 0
v vmax + 1 6.2312 215 0
v vmax + 1 6.2312 210 0
v vmax + 1 6.2312 205 0
v vmax + 1 6.2312 200 0
v vmax + 1 6.2312 195 0
v vmax + 1 6.2312 190 0

csys 3
v vmax + 1 0 -1.0097 6.1489
v vmax + 1 0 0.0089 6.1376
v vmax + 1 0 0.0089 6.13

csys 2
v vmax + 1 6.13 305 0
v vmax + 1 6.13 300 0
v vmax + 1 6.13 295 0
v vmax + 1 6.13 290 0
v vmax + 1 6.13 285 0
v vmax + 1 6.13 280 0
v vmax + 1 6.13 275 0
v vmax + 1 6.13 270 0
v vmax + 1 6.13 265 0
v vmax + 1 6.13 260 0
v vmax + 1 6.13 255 0
v vmax + 1 6.13 250 0
v vmax + 1 6.13 245 0
v vmax + 1 6.13 240 0
v vmax + 1 6.13 235 0
v vmax + 1 6.13 230 0
v vmax + 1 6.13 225 0
v vmax + 1 6.13 220 0
v vmax + 1 6.13 215 0
v vmax + 1 6.13 210 0
v vmax + 1 6.13 205 0
v vmax + 1 6.13 200 0
v vmax + 1 6.13 195 0
v vmax + 1 6.13 190 0

v vmax + 1 6.13 187 0
v vmax + 1 6.13 185 0
v vmax + 1 6.13 183 0
v vmax + 1 6.13 181.5 0
#def dvm vmax - vmo
save 18

resu 18
vp

spldelete all
#def bp1 vmax - 59
spline 1 vlist vmax - 60 -bp1 vmax - 58 vmax - 57 vmax - 56 vmax - 55
#def bp2 vmax - 30
spline 2 vran vmax - 55 vmax - 29
splm 2 modi vmax - 30 vmax - 30 * -1
spline 3 vlist vmax - 29 vmax - 28
save 19

resu 19
sp
```

```
spline 4 vlist vmax - 28 vmax * -1 vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8
spline 4 vlist vmax - 9 vmax - 10 vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax - 16 vmax - 17
spline 4 vlist vmax - 18 vmax - 19 vmax - 20 vmax - 21 vmax - 22 vmax - 23 vmax - 24 vmax - 25 vmax - 26 vmax -
27 vmax - 60
sp

vcopy 2 dvm vset 0 0 span

#def bp5 vmax - 59
spline 5 vlist vmax - 60 -bp5 vmax - 58 vmax - 57 vmax - 56 vmax - 55
#def bp6 vmax - 30
spline 6 vlist vmax - 55 vmax - 54 vmax - 53 vmax - 52 vmax - 51 vmax - 50 vmax - 49 vmax - 48 vmax - 47
spline 6 vlist vmax - 46 vmax - 45 vmax - 44 vmax - 43 vmax - 42 vmax - 41 vmax - 40 vmax - 39 vmax - 38 vmax -
37 vmax - 36 vmax - 35 vmax - 34 vmax - 33 vmax - 32 vmax - 31 -bp6 vmax - 29
spline 7 vlist vmax - 29 vmax - 28
spline 8 vlist vmax - 28 vmax * -1 vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8
spline 8 vlist vmax - 9 vmax - 10 vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax - 16 vmax - 17 vmax - 18
vmax - 19 vmax - 20 vmax - 21 vmax - 22 vmax - 23 vmax - 24 vmax - 25 vmax - 26 vmax - 27 vmax - 60
sp

bldelete all
block 13 vmax - 29 vmax - 28 vmax - 60 vmax - 55 vmax - 90 vmax - 89 vmax - 121 vmax - 116

blfactors 13 5 70 spnblk 7
blex 13
cset news cglist 7 2
VIEW      1.0000e+000     0.0000e+000     0.0000e+000
VUP       0.0000e+000     1.0000e+000     0.0000e+000
FOCAL  COORD     2.5000e-001    -6.5494e-001     6.0758e+000
SCALE  VALUE     4.0470e-001
cp
save 23

resu 23
autosc on
focal center
/////Exhaust Duct Second Block////////////////
vset none
csys 3
v vmax + 1 0 -4.9454 -3.7909
v vmax + 1 0 -7.2027 -3.7909//bp?
v vmax + 1 0 -9.46 -3.7909
vp
csys 0
local 4 cyli 0 -0.57 -2.72 0 90 0 0 0
csys 4
v vmax + 1 8.89 -90 0
v vmax + 1 8.89 -95 0
v vmax + 1 8.89 -100 0
v vmax + 1 8.89 -105 0
v vmax + 1 8.89 -110 0
v vmax + 1 8.89 -115 0
v vmax + 1 8.89 -120 0
v vmax + 1 8.89 -125 0
v vmax + 1 8.89 -130 0
v vmax + 1 8.89 -135 0
v vmax + 1 8.89 -140 0
v vmax + 1 8.89 -145 0
v vmax + 1 8.89 -150 0
v vmax + 1 8.89 -155 0
v vmax + 1 8.89 -160 0
```

```
v vmax + 1 8.89 -165 0
v vmax + 1 8.89 -170 0

csys 3
v vmax + 1 0 -1.0097 6.1489
v vmax + 1 0 -1.0097 6.1489

vp

csys 2
v vmax + 1 6.2312 305 0
v vmax + 1 6.2312 300 0
v vmax + 1 6.2312 295 0
v vmax + 1 6.2312 290 0
v vmax + 1 6.2312 285 0
v vmax + 1 6.2312 280 0
v vmax + 1 6.2312 275 0
v vmax + 1 6.2312 270 0
v vmax + 1 6.2312 265 0
v vmax + 1 6.2312 260 0
v vmax + 1 6.2312 255 0
v vmax + 1 6.2312 250 0
v vmax + 1 6.2312 245 0
v vmax + 1 6.2312 240 0
v vmax + 1 6.2312 235 0
v vmax + 1 6.2312 230 0
v vmax + 1 6.2312 225 0
v vmax + 1 6.2312 220 0
v vmax + 1 6.2312 215 0
v vmax + 1 6.2312 210 0
v vmax + 1 6.2312 205 0
v vmax + 1 6.2312 200 0
v vmax + 1 6.2312 195 0
v vmax + 1 6.2312 190 0

vp
vmax

spldelete all
spline 1 vran vmax - 45 vmax - 43 1
spline 2 vran vmax - 43 vmax - 25 1
spline 3 vlist vmax - 24 vmax vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8
spline 3 vlist vmax - 9 vmax - 10 vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax - 16 vmax - 17 vmax - 18
vmax - 19 vmax - 20 vmax - 21 vmax - 22 vmax - 23 vmax - 45
sp
vmax

save 44

resu 44
vcopy 2 46 vset 0 0 span
vp
vmax

spline 4 vran vmax - 45 vmax - 43 1
spline 5 vran vmax - 43 vmax - 25 1
spline 6 vlist vmax - 24 vmax vmax - 1 vmax - 2 vmax - 3 vmax - 4 vmax - 5 vmax - 6 vmax - 7 vmax - 8
spline 6 vlist vmax - 9 vmax - 10 vmax - 11 vmax - 12 vmax - 13 vmax - 14 vmax - 15 vmax - 16 vmax - 17 vmax - 18
vmax - 19 vmax - 20 vmax - 21 vmax - 22 vmax - 23 vmax - 45
sp

bldelete all
```

```
block 14 vmax - 25 vmax - 24 vmax - 45 vmax - 43 vmax - 71 vmax - 70 vmax - 91 vmax - 89

blfactors 14 10 30 spnblk 8
blcd 14 5 30 1 / 1.01025
blcd 14 6 30 1 / 1.01025
blcd 14 7 30 1
blcd 14 8 30 1
blex 14

cset news cgro 8
cp

vmax


/////Build Exhaust Wall Extension//////////////////////////////////////////////////

csys 3
vset none
v vmax + 1 0 -4.9454 -3.7909
v vmax + 1 0 -7.2027 -3.7909
v vmax + 1 0 -9.46 -3.7909
v vmax + 1 0 -4.9454 -8.825
v vmax + 1 0 -7.2027 -8.825
v vmax + 1 0 -9.46 -8.825
vp

spldelete all
#def bp1 vmax - 4
spline 1 vlist vmax - 3 -bp1 vmax - 5
spline 2 vlist vmax - 5 vmax - 2
#def bp3 vmax - 1
spline 3 vlist vmax - 2 -bp3 vmax
spline 4 vlist vmax vmax - 3
sp

vcopy 2 6 vset span 0 0
vp
#def bp5 vmax - 4
spline 5 vlist vmax - 3 -bp5 vmax - 5
spline 6 vlist vmax - 5 vmax - 2
#def bp7 vmax - 1
spline 7 vlist vmax - 2 -bp7 vmax
spline 8 vlist vmax vmax - 3
sp

vmax

bldelete all
block 6 vmax - 3 vmax - 5 vmax - 2 vmax vmax - 9 vmax - 11 vmax - 8 vmax - 6
blfactors 6 10 10 spnblk 9
blex 6


/////Build HP Cavity///////////////////////////////////////////////////////////
/////HPC First Block//////////////
csys 0
csys 3
vset none
vset news

v vmax + 1 0 4.8676 3.726
```

```
v vmax + 1 0 4.8852 3.7369
v vmax + 1 0 4.8757 3.7578
v vmax + 1 0 4.8741 3.7775
v vmax + 1 0 4.8790 3.7954
v vmax + 1 0 4.8871 3.8086
v vmax + 1 0 4.9406 3.8754

csys 2

v vmax + 1 6.2792 175 0
v vmax + 1 6.2792 170 0
v vmax + 1 6.2792 165 0
v vmax + 1 6.2792 160 0
v vmax + 1 6.2792 155 0
v vmax + 1 6.2792 150 0//breakpoint
v vmax + 1 6.2792 145 0
v vmax + 1 6.2792 140 0
v vmax + 1 6.2792 135 0
v vmax + 1 6.2792 130 0

csys 3

v vmax + 1 0 -.0605 6.2789
v vmax + 1 0 .0075 6.2675
v vmax + 1 0 .0329 6.262
v vmax + 1 0 .053 6.249
v vmax + 1 0 .0655 6.2324
v vmax + 1 0 .0729 6.2016
v vmax + 1 0 .0676 6.1767
v vmax + 1 0 .0516 6.1543
v vmax + 1 0 .0324 6.1423
v vmax + 1 0 .0089 6.1376
v vmax + 1 0 .0089 6.13

csys 2

v vmax + 1 clnc 175 0
v vmax + 1 clnc 170 0
v vmax + 1 clnc 165 0
v vmax + 1 clnc 160 0
v vmax + 1 clnc 155 0
v vmax + 1 clnc 150 0//breakpoint
v vmax + 1 clnc 145 0
v vmax + 1 clnc 140 0
v vmax + 1 clnc 135 0
v vmax + 1 clnc 130 0
v vmax + 1 clnc 127.5 0
vp

vmax
spldelete all
#def bp1 vmax - 37
spline 1 vlist vmax - 38 -bp1 vmax - 36 vmax - 35 vmax - 34 vmax - 33 vmax - 32
spline 2 vlist vmax - 32 vmax - 22 vmax - 23 vmax - 24 vmax - 25 vmax - 26 vmax - 27 vmax - 28 vmax - 29 vmax -
30 vmax - 31 vmax - 21
#def bp3 vmax - 12
spline 3 vlist vmax - 21 vmax - 20 vmax - 19 vmax - 18 vmax - 17 vmax - 16 vmax - 15 vmax - 14 vmax - 13 -bp3
vmax - 11
spline 4 vlist vmax - 11 vmax - 10 vmax - 9 vmax - 8 vmax - 7 vmax - 6 vmax - 5 vmax - 4 vmax - 3 vmax - 2 vmax - 1
vmax vmax - 38
sp
```

```
csys 3
vcopy 2 39 vset span 0 0
vp

#def bp5 vmax - 37
spline 5 vlist vmax - 38 -bp5 vmax - 36 vmax - 35 vmax - 34 vmax - 33 vmax - 32
spline 6 vlist vmax - 32 vmax - 22 vmax - 23 vmax - 24 vmax - 25 vmax - 26 vmax - 27 vmax - 28 vmax - 29 vmax -
30 vmax - 31 vmax - 21
#def bp7 vmax - 12
spline 7 vlist vmax - 21 vmax - 20 vmax - 19 vmax - 18 vmax - 17 vmax - 16 vmax - 15 vmax - 14 vmax - 13 -bp7
vmax - 11
spline 8 vlist vmax - 11 vmax - 10 vmax - 9 vmax - 8 vmax - 7 vmax - 6 vmax - 5 vmax - 4 vmax - 3 vmax - 2 vmax - 1
vmax vmax - 38
sp

vmax

bldelete all
block 7 vmax - 21 vmax - 32 vmax - 38 vmax - 11 vmax - 60 vmax - 71 vmax - 77 vmax - 50
blfactors 7 20 10 spnblk 10
blex 7
cset news cgro 10
cp

/////HPC Second Block/////////////////////////////////////
vset none
csys 3

v vmax + 1 0 4.9406 3.8754
v vmax + 1 0 5.29 4.5
v vmax + 1 0 5.59 5.68
v vmax + 1 0 5.29 6.99
v vmax + 1 0 5.05 7.4156
v vmax + 1 0 4.2003 8.3185
v vmax + 1 0 3.3509 8.9136//breakpoint ?????
v vmax + 1 0 2.9006 9.1322
v vmax + 1 0 2.502 9.2577
v vmax + 1 0 1.77 9.35
v vmax + 1 0 .8759 9.221
v vmax + 1 0 0 8.84
v vmax + 1 0 -.58 8.16
v vmax + 1 0 -.79 7.39
v vmax + 1 0 -.6908 7.0132
v vmax + 1 0 -.5907 6.7994
v vmax + 1 0 -.3601 6.4987
v vmax + 1 0 -.2105 6.3704
v vmax + 1 0 -.0605 6.2789
v vmax + 1 0 -.0605 6.2789
vp

csys 2

v vmax + 1 6.2792 175 0
v vmax + 1 6.2792 170 0
v vmax + 1 6.2792 165 0
v vmax + 1 6.2792 160 0
v vmax + 1 6.2792 155 0
v vmax + 1 6.2792 150 0//breakpoint
v vmax + 1 6.2792 145 0
v vmax + 1 6.2792 140 0
v vmax + 1 6.2792 135 0
v vmax + 1 6.2792 130 0
```

```
csys 3

v vmax + 1 0 4.9406 3.8754
vp
vmax

spldelete all
spline 1 vran vmax - 30 vmax - 12 1
spline 2 vran vmax - 11 vmax 1
sp

vcopy 2 31 vset span 0 0
vp

spline 3 vran vmax - 30 vmax - 12 1
spline 4 vran vmax - 11 vmax 1
sp

bldelete all
block 8 vmax - 12 vmax - 30 vmax vmax - 11 vmax - 43 vmax - 61 vmax - 31 vmax - 42
blfactors 8 30 10 spnblk 11
blex 8
cset news cgro 11
cset all
cp

view -1 0 0
cp
/////////////////////////////////////////////////////////////////////////////////////////////////////////
////////////////////////////////COMPLETE WITH STRUCTURE////////////////////////////////////////////////
/////////////////////////////////////////////////////////////////////////////////////////////////////////
save 33

resu 33
/////Merge vertices in non-sliding cell groups///////////
cset none
cset news cgro 2
cset cgro 3
cset cgro 4
cset cgro 5
cset cgro 6
cset cgro 7
cset cgro 8
cset cgro 9
cset cgro 10
cset cgro 11
cp

vset news cset
vmerge vset 0.0005

cset news cgro 3
cset cgro 10
cp
vset news cset
vmerge vset 0.0001

cset news cgro 8
cset cgro 9
cp
vset news cset
```

```
vmerge vset 0.0001

save 66

resu 66
/////Find embedded cell sets//////////////////////////////
cset news cgro 3
vcdis cset
cset cgro 2
cp
esfind 2 3 0.01 10 11 12

cset news cgro 2
csys 2
cset gxyzrange 5 6.13 6.135 0 22 0 span
cset gxyzrange 5 6.13 6.135 300 360 0 span
cp

cp
esfind 2 5 0.02 30 11 12

cset news cgro 5
cset cgro 6
cp
esfind 5 6 0.01 30 11 12


cset news cgro 3
cset cgro 4
cp
esfind 3 4 0.005 30 11 12

cset news cglist 2 7
csys 2
cp
esfind 2 7 0.02 30 11 12

cset news cgro 2
cset cgro 10
cp
esfind 2 10 0.05 30 11 12

cset news cgro 7
cset cgro 8
cp
esfind 8 7 0.02 10 11 12

cset news cgro 7
cset cgro 10
cp
esfind 10 7 0.0001 10 11 12

cset news cgro 7
cset cgro 5
cp
esfind 5 7 0.0001 10 11 12

cset news cgro 10
cset cgro 11
cp
esfind 10 11 0.005 30 11 12
```

```
/////Compress all vertex and cell numbers/////////////////

save 1
resu 1

// Boundaries
// Inlet
cset none
cset cgro 4
view 1 0 0
cp
bface 1 east
bset news bgro 1
bp


// Outlet
cset none
cset cgro 9
view 0 0 -1
cp
bface 2 north
bset bgro 2
bp


// Symmetry
// Merge vertices first otherwise
// boundaries will be created on axis
csys 3
cset all
view 1 0 0
pltype hsurf
cp
bview 3 10
view -1 0 0
pltype hsurf
cp
 bview 3 10

// Attached boundary 1
csys 2
cset news cgro 0
cset news gxyzrange 0 6 6.2 0 360 0 span
view 1 1 1
cp
bface 4 east
bset news bgro 4
bp

// Attached boundary 2
cset news cgro 2
view 1 1 1
cp
bface 5 west
bset bgro 5
bp

//Attached Boundary 3
csys 2
cset news cgro 0
cset news gxyzrange 0 4.15 4.2 0 360 0 span
```

```
view 1 1 1
cp
bface 6 west
bset news bgro 6
bp

//Attached Boundary 4

cset news cgro 1
cset news gxyzrange 1 4.0 4.15 0 360 0 span
view 1 1 1
cp
bface 7 east
bset news bgro 7
bp
bset bgro 6
bp

save 2

resu 2
movi on stand //yes
#def step 1.5e-6 0
// Note 1
// NB Watch out for this:
// #def speed 5000 //in RPM
// rather use this:
#def speed 3000      0              //in RPM


unst on step fixed 10 1 //1 1.05
unst on step adjust 10 1.2 10

#def dpt speed * 360 / 60 * step 0
slide on


ssdef 1 2 0 0 speed / 2 0 arbitr 4 5 0.000001 20 const 0 0 2
ssdef 2 2 0 0 speed / 2 0 arbitr 6 7 0.000001 20 const 0 0 1

ssdef 1 2 0 0 speed / 2 0 arbitr 4 5 0.0001 10 const 0 0 2
ssdef 2 2 0 0 speed / 2 0 arbitr 6 7 0.0003 10 const 0 0 1

bgdef 4 attach
2 0
bgdef 5 attach
2 0
bgdef 6 attach
2 0
bgdef 7 attach
2 0

//energy on
bgdef 3 symm

bgdef 1 pres
-3000 300 0.05 0.001
//bgdef 1 inlet const
//2 -12.62 0 0 1.2 0.05 0.001 0.001
bgdef 2 pres
0 300 0.05 0.001
```

```
mdef 0 fluid

cgdef 0 0
cgdef 1 0
cgdef 2 0
cgdef 3 0
cgdef 4 0
cgdef 5 0
cgdef 6 0
cgdef 7 0
cgdef 8 0
cgdef 9 0
cgdef 10 0
cgdef 11 0

save 5

resu 5

cset all
vset news cset
vset unsel
vdel vset

vcomp all
ccomp all
wmesh .0254

mate 0
turb on
dens const 1.204
```

//density ideal yes 28.7

```
visc const 0.000018
pgrad zero
pref 100000 cm1

rest init
iter 60000 100 1000
//restart previous 496
unst on 1e-6 adjust 1 1.5 50
```

unst on 1e-6 adjust 0.9 1.2 50

```
conv 0.001
switch 21 on
wdef

save

plty wire
view 1 2 3
bset news bgro 1

bset bgro 0
bset bgro 1
bset bgro 2
bset bgro 4
bset bgro 5
bset bgro 6
bset bgro 7
bp
```

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